Compensatory Mitigation and Stream Restoration Plan for Schultz Creek

Volume 1 of 2

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PREPARED FOR:
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Compensatory Mitigation and Stream Restoration Plan for Schultz Creek; LRL-2009-xxx, AI # xxxxx

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Prepared for Kentucky Department of Fish & Wildlife Resources

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EXECUTIVE SUMMARY

As part of their in-lieu fee agreement, the Kentucky Department of Fish & Wildlife Resources (KY Fish & Wildlife) proposes to conduct stream restoration in the Schultz Creek watershed near Vanceburg in Greenup County, Kentucky. The project includes the restoration of approximately 2,750 linear feet of Schultz Creek, along with 152 linear feet of Dry Fork, a left bank tributary of Schultz Creek that enters near the upstream end of the project. Schultz Creek flows into Tygart's Creek located within the Ohio River basin.

A priority 3 restoration approach will be implemented throughout the project area, creating access to a floodplain and providing in-stream aquatic habitat. A number of low water ford crossings will be installed for farm equipment and livestock access. The project will also involve installing new fence lines to define the easement boundaries and property parcels.

Goals and Objectives

The objective of this Mitigation Plan is to provide a functional and structural lift at the proposed restoration site by:

- Meeting guidelines provided in the Mitigation Rule (USEPA & USACE, 2008);
- Providing Ecological Integrity Units as prescribed in the Eastern Kentucky Stream Assessment Protocol (EKSAP; Sparks et al., 2003);
- Restoring geomorphically stable conditions, such that the correct stream type is in the appropriate valley type;
- Restoring hydrologic and geomorphic functions by designing channels to only transport the bankfull flow and reduce sediment supply by stabilizing eroding streambanks;
- Restoring biologic functions by providing aquatic and terrestrial habitat in the form of large woody debris and adjacent riparian vegetation. The in-stream structures and planted riparian zones will also provide additional dissolved oxygen and cooler temperatures..

Mitigation Approach

KY Fish & Wildlife applied the EKSAP on each of the restoration reaches located within the project area. The EKSAP provides an estimate of the ecological integrity of a headwater stream ecosystem relative to reference stream conditions in the same region. The output of the model is called the Ecological Integrity Index (EII) and ranges from 0.0 – 1.0. The EII is calibrated such that a score of 1.0 is given for stream conditions indicative of minimal disturbance or reference streams in the region. For each mitigation reach, the EII is multiplied by the stream length to provide a total of Ecological Integrity Units (EIUs).

Results from the EKSAP demonstrate that the restoration efforts implemented at the project provide a functional lift of 110 linear feet and 1,260 EIUs (Table ES 1.1).

Table ES 1.1
Mitigation Sites, EIU Summary

Reach	Pre-existing Conditions			Predicted Conditions			Functional Lift
	Length (ft)	EII	EIU	Length (ft)	EII	EIU	Difference in EIUs
Schultz Creek – Reach 1	582	0.55	320	583	0.97	566	246
Schultz Creek – Reach 2	2,109	0.55	1,160	2,167	0.97	2,102	942
Dry Fork	101	0.56	57	152	0.85	129	72
GRAND TOTAL	**2,792**	**N/A**	**1,537**	**2,902**	**N/A**	**2,797**	**1,260**

Notes: EII = Ecological Integrity Index (the output from the EKSAP model), EIU = Ecological Integrity Unit.

Monitoring & Success Standards

Monitoring will be conducted in order to 1) document project successes, and 2) identify failures for which a contingency plan must be implemented. Channel stability, stream functions, benthic macroinvertebrates, water quality, and vegetation survival will be monitored along each mitigation reach for a minimum of five years following the completion of construction. Table ES 1.2 provides a list of each component that will be measured during monitoring along with the criteria used to determine success with each component. It should be noted that biotic standards are contingent upon water quality parameters' remaining within recommended ranges for freshwater organisms.

Table ES 1.2
Success Criteria and Monitoring Actions

Type/Category	Criteria	Year 1	Year 2	Year 3	Year 4	Final Value (after 5 years)
Geomorphology	BEHI (Max)	High (Below 35)		Moderate (Below 30)		Low (Below 20)
	Sediment Production From Banks (bankpins or cross-sections)	Report annual sediment production from banks	Report annual sediment production from banks	Report annual sediment production from banks	Report annual sediment production from banks	Mean sediment production from banks less than 0.5 feet/year over years 3-5
	Stable banks and channel (photos)*	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually. W/D ratio will not increase by more than 1.2 from design criteria, BHR will be less than 1.2, ER will be less than 1.4.
Hydrology	Crest gage or observation	Report greater than bankfull flows	At least 1 BKF event recorded	At least 1-2 cumulative BKF events recorded	At least 1-2 cumulative BKF events recorded	At least 3 cumulative BKF events recorded
Vegetation	Min % Trees Native	90%	90%	90%	90%	90%
	Max % Trees Non-native	10%	10%	10%	10%	10%
	Max.% Trees Invasive	10%	10%	10%	10%	10%
	Max % Invasive plants (herbaceous or woody)	10%	10%	10%	10%	10%
	Min. Native Stem Density per acre	150	150	150	300	300
	Maximum Percent any one tree Species	50%	50%	50%	35%	25%
	Species List (Scientific & Common Name, Wetland Status Indicator, Native vs. Non-Native vs. Invasive)	Yes	Yes	Yes	Yes	Yes

Type/Category	Criteria	Year 1	Year 2	Year 3	Year 4	Final Value (after 5 years)
Habitat	USEPA RBP	Total score = 145		Total score = 150		Total score > 155
Biotic*	KDOW Methods (benthic macroinvertebrates)	Spring sample; year 1		Spring sample; year 3		Spring sample; year 5. *Equivalent or higher metrics and values than baseline conditions*

*RBP biotic metric will not be used to determine project success/failure, but goals have been set for year 5

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1.0 INTRODUCTION AND BACKGROUND

1.1 Project Description and Location

Kentucky Department of Fish & Wildlife Resources (KY Fish & Wildlife) is in the process of obtaining all necessary state and federal permits for the proposed stream restoration project, which includes approximately 2,750 linear feet of Schultz Creek and 152 linear feet of Dry Fork, a left bank tributary of Schultz Creek. The project area is located approximately 15-miles east of Vanceburg in Greenup County, Kentucky (Figure 1.1). Schultz Creek flows into Tygarts Creek located within the Ohio River basin (Figure 1.2).

As part of the stream restoration project, it will be necessary to temporarily impact jurisdictional waters of the U.S.; therefore, the project will require a U.S. Army Corps of Engineers (USACE) permit and its corresponding state permits. Under Section 404 of the Federal Water Pollution Control Amendments of 1972, commonly referred to as the Clean Water Act, the USACE regulates the discharge of dredge and fill material into the "waters of the United States (U.S.)."

Therefore, KY Fish & Wildlife has requested that Michael Baker Jr. Inc. (Baker) prepare this Final Compensatory Mitigation and Restoration Plan (Final Mitigation Plan) for the proposed activities in jurisdictional waters in accordance with the *Compensatory Mitigation for losses of Aquatic Resources; Final Rule* (USEPA & USACE, 2008), hereafter referred to as the Mitigation Rule. This Final Mitigation Plan, as requested by KY Fish & Wildlife, includes a minimum of approximately fifty percent completed designs and their corresponding plan sheets.

1.2 Watershed Delineation

The project area encompasses a portion of Schultz Creek, which has been determined to be perennial. The project area also encompasses a portion of an intermittent tributary to Schultz Creek named Dry Fork. The project area is within the Hydrologic Unit Code (HUC) 05090103 (Little Scioto-Tygarts), as identified by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). The portion of Schultz Creek upstream of the mouth of Dry Fork is referred to herein as Reach 1, while the portion of Schultz Creek downstream of Dry Fork is Reach 2. Reach 1 currently extends 582 linear feet, and Reach 2 currently extends 2,109 linear feet, and Dry Fork currently extends 101 linear feet into the project area.

2.0 GOALS AND OBJECTIVES

The objective of this Final Mitigation Plan is to provide a functional and structural lift at the proposed restoration site by:

- Meeting guidelines provided in the Mitigation Rule (USEPA & USACE, 2008);
- Providing Ecological Integrity Units as prescribed in the Eastern Kentucky Stream Assessment Protocol (EKSAP; Sparks et al., 2003);
- Restoring geomorphically stable conditions, such that the correct stream type is in the appropriate valley type;
- Restoring hydrologic and geomorphic functions by designing channels to only transport the bankfull flow and reduce sediment supply by stabilizing eroding streambanks;
- Restoring biologic functions by providing aquatic and terrestrial habitat in the form of large woody debris and adjacent riparian vegetation. The in-stream structures and planted riparian zones will also provide additional dissolved oxygen and cooler temperatures.

3.0 SITE SELECTION

3.1 Schultz Creek & Dry Fork

This particular section of the Schultz Creek drainage basin was selected by KY Fish & Wildlife as a possible mitigation site for stream restoration for a number of reasons. First, with the growing number of impacts in the Eastern Kentucky region, there is a demand for mitigation within the vicinity to offset impacts. Selecting mitigation sites within the same physiographic region or service area as impact sites will result in a greater likelihood of showing off-set, both structurally and functionally.

Second, the landowners in this area of the Schultz Creek watershed were willing to sign a conservation easement. Each of the proposed mitigation area landowners (Section 4.0) were willing to sign a conservation easement to ensure that the stream restoration area would be protected in perpetuity after mitigation measures was applied. The agreement is to protect a minimum riparian zone width of 50-feet from the water edge on each bank. The ability to obtain long term site protection is one of the driving factors in the selection of mitigation sites.

Finally, surveys of the proposed mitigation area showed that the reaches were laterally and vertically unstable and in need of full restoration. For example, the section of Schultz Creek proposed for restoration is severely incised and overly wide, causing massive bank erosion and adjacent land loss. The stream has been channelized, dredged, relocated, and impacted from livestock access.

Based on the selection criteria described above, Schultz Creek and Dry Fork appeared to be ideal candidates for stream restoration for mitigation purposes.

4.0 SITE PROTECTION INSTRUMENT

The current landowners at the proposed mitigation site include four (4) different private landowners. A 50-foot riparian buffer on each streamside will be provided along the stream mitigation areas (Appendix E). A copy of the stream easement document is included in Appendix E. The easement document will be filed in the Greenup County courthouse. Contact information for the landowners is provided below.

Ishmel Howard
4806 State Route 784
South Shore, KY 41175
606-932-3949

Robert Howard
5013 State Route 784
South Shore, KY 41175
(606) 932-2030

Jeff Sparks Scott and Trina Newberry
PO Box 651
South Shore, KY 41175
606-932-9866

4700 State Route 784
South Shore, KY 41175
(606) 932-4553

4.1 Potential Constraints

The project area was assessed for potential constraints. No major constraints have been identified during project design development.

4.1.1 Property Ownership and Boundary

KY Fish & Wildlife has obtained site protection requirements with the landowners, including Ishmel Howard, Robert Howard, Jeff Sparks, and Scott Newberry. A 100-foot riparian buffer (50-feet on each streamside) will be protected on each restoration reach with a signed easement document (Appendix C).

4.1.2 Site Access

The project is located parallel to Route 784, 1.3 miles north of the Route 10 junction, in northern Greenup County. Driving directions are as follows: from Interstate 64, take exit 172 and travel north onto Route 9 towards Vanceburg. Approximately three miles before Vanceburg, turn right onto Route 10. Approximately five miles past Lewis/Greenup County line turn left on Route 784 and travel approximately 1.3 miles on Route 784 to the site.

Temporary access roads constructed to gain access to the site, or otherwise required shall be kept to a minimum and only constructed upon approval from KY Fish & Wildlife. Temporary access roads shall be returned to the original or design contour as nearly as possible and revegetated according to Section 7.4.2 of this report.

4.1.3 Utilities

There are no known active utilities throughout the project area. However, all areas that will be included with the construction right-of-way will need to be verified and located by the selected contractor before construction is initiated.

5.0 BASELINE INFORMATION

5.1 Reach Identification

5.1.1 Schultz Creek

The main stem of Schultz Creek located within the mitigation project was divided into two reaches based on a significant change in drainage area (Figure 1.2 and Figure 1.3). Reach 1, located upstream of the confluence with Dry Fork, had a drainage area of 9.5 square miles. Reach 2, located downstream of the confluence with Dry Fork, had a drainage area of 13.4 square miles. Dry Fork had a drainage area of 3.8 square miles.

5.2 Hydrologic and Hydraulic Assessment

5.2.1 Watershed Hydrology

The project area is located in eastern Kentucky and is located within the same physiographic region as the streams studied in the Watershed analyses for this project. Discharges for the restoration reaches were calculated from the USGS Regional Regression Equations as detailed in Water-Resources Investigations (WRI) Reports 03-4180 (Kentucky), 00-4080 (West Virginia), 03-4164 (Ohio) and Scientific Investigations Report 2005-5153 (Ohio). Baker compared the regression equations for each reach, from the three states, that corresponded to the same physiographic region and drainage area as the streams in the project. Baker also overlaid discharges from nearby gage stations in order to find the regression equation that would be appropriate for the bankfull discharges along Schultz Creek.

The Reach 1 results from the USGS Regional regression equations for the bankfull discharge were mixed and ranged from approximately 530 cubic feet per second (cfs) to 780 cfs with a mean average of 655 cfs. However, when comparing nearby gage stations, the Reach 1 discharge (642 cfs) was very close to the mean average of the USGS Regional regression equations (655 cfs).

The Reach 2 results from the USGS Regional regression equations for the bankfull discharge were mixed and ranged from approximately 1,145 cfs to 1,567 cfs with a mean average of 1,356 cfs. These results were not close to the nearby gage station's regression line that had a value of 817 cfs. However, the 817 cfs provided a discharge that was more suitable and necessary to complete the hydraulic and sediment transport analyses, which describe the stream's ability to move water and sediment. The primary purpose of this analysis was to determine the bankfull discharge, which is the flow that creates the channel dimension under natural conditions.

5.2.2 Channel Hydraulics

Existing and design riffle cross-sections along Schultz Creek were analyzed for both reaches to see what discharge is needed to be able to reach its floodplain (Figure 5.1). The existing and design channel discharges for the Reach 1 were 1,484 cfs and 642 cfs, respectively (Figure 3.1). The existing and design channel discharges for Reach 2 were 1,377 cfs and 817 cfs, respectively (Figure 3.2). According to the USGS regression equations from KY (2003), OH (2005, 2003), and WV (2000), the existing channel discharges would need a discharge from a 14- to 17-year precipitation event to be able to reach its existing floodplain. The design bankfull discharges will allow smaller discharges to reach its floodplain more frequently; the design will create the floodplain at a lower elevation and the existing floodplain will become a terrace.

5.3 Geomorphic Assessment

A geomorphic assessment was completed to compliment the hydrology and hydraulic analysis in Section 5.2 and to determine stream stability (vertical and lateral) and bedform diversity. More specifically, the

hydrology, hydraulic and geomorphic processes work together to create the channel geometry or form. Longitudinal and cross-section surveys were performed in representative reaches as described in Section 5.1. In addition, bed material samples were collected to classify the stream and perform sediment transport analyses. The following sections of this report summarize the survey results. Surveyed cross-sections, profiles, and sediment data are included in Appendix F. A photo log of each of the streams and their representative reaches is included in Appendix G.

5.3.1 Classification

The mitigation project reaches classified as stream types B4c and F4 have overly wide bankfull widths and shallow depths resulting in very large width/depth ratios (Table 5.1). Entrenchment ratios and channel slopes were very low. Dominant particles sizes were in the gravel size distribution range.

5.3.2 Bedform Diversity

Existing conditions data (Table 5.1) of the geomorphic characterization study, including review of the longitudinal profile survey indicates bedform diversity and in-stream aquatic habitat consists of many long shallow pools with transverse riffles between large sediment deposition piles. Longitudinal data shows that there were approximately 42 percent riffle and 58 percent pool. Pool-to-pool spacing averaged 152 feet apart, where design criteria specify a maximum between 287 feet (Reach 1) and 330 feet (Reach 2), indicating there is a general lack of pools.

The goal of the restoration of these areas is to obtain a more balanced riffle and pool ratio while creating a more meandering system in the designed Rosgen C stream type. In order to do so, the channel will be restored throughout the project reaches, while in-stream aquatic habitat in the form of rock and log structures will be installed throughout. The channel will be re-routed back into an abandoned, remnant channel. Channel restoration with the addition of in-stream aquatic habitat is expected to obtain the natural balance of riffle and pool ratios these stream types typically exhibit.

5.3.3 Lateral Stability

The potential for streambank erosion was assessed by KY Fish & Wildlife using the Bank Erosion Hazard Index (BEHI) analysis (Rosgen, 1994). The BEHI was conducted approximately 1,500 linear feet downstream from the most upstream end of the project reach. The assessment included an approximately 650-linear foot reach of bank, which is representative of the majority of the project reach. The BEHI value was a 50.5, indicating there is an extreme erosion rate in this particular reach of Schultz Creek.

Bank samples and corresponding sediment analysis demonstrate that the majority of the sediment in the reach came from eroding streambanks. The restoration efforts proposed will focus on restoring the channel to improve lateral stability, resulting in lower BEHI scores.

Table 5.1
Existing Conditions Geomorphic/Stream Classification Data For Schultz Creek

Parameter		Schultz Creek Reach 1	Schultz Creek Reach 2
Rosgen Stream Type		B4c	F4
Drainage Area (sq mi)		9.5	13.4
Reach Length Surveyed (ft)		856.4	2286.9
Dimension	Bankfull Width (ft)	82.3	67.8
	Bankfull Mean Depth (ft)	1.6	2.0
	Width/Depth Ratio	50.3	34.8
	Bankfull Area (sq ft)	134.7	132.1
	Bankfull Max Depth (ft)	3.0	2.8
	Width of Floodprone Area (ft)	163.1	84.4
	Entrenchment Ratio	2.0	1.2
	Max Pool Depth (ft)	4.7	4.9
	Ratio of Max Pool Depth to Bankfull Depth	2.9	2.5
	Pool Width (ft)	57.4	81.4
	Ratio of Pool Width to Bankfull Width	0.7	1.2
	Pool to Pool Spacing (ft)	98.7	178.2
	Ratio of Pool to Pool Spacing to Bankfull Width	1.2	2.6
	Bank Height Ratio	2.3	3.3
Pattern	Meander Length (ft)*	584.5	769.6
	Meander Length Ratio	7.1	11.3
	Radius of Curvature (ft)	163.0	240.1
	Radius of Curvature Ratio	2.0	3.5
	Meander Belt Width (ft)*	202.2	73.6
	Meander Width Ratio	2.5	1.1
	Sinuosity	1.3	1.1
Profile	Valley Slope (ft/ft)	0.0060	0.0053
	WS Slope (ft/ft)	0.0075	0.0057
	Channel Slope (ft/ft)	0.0074	0.0060
	Pool Slope (ft/ft)	0.0022	0.0006
	Ratio of Pool Slope to WS Slope	0.3	0.1

5.3.4 Vertical Stability

The bank height and entrenchment ratios are measured in the field to assess vertical stability. The bank height ratio is measured as the ratio of the lowest bank height divided by a maximum bankfull depth Table 5.2 shows the relationship between bank height ratio (BHR) and vertical stability developed by Rosgen (2001).

Table 5.2
Conversion of Bank Height Ratio (Degree of Incision) to Adjective Rankings of Stability (Rosgen, 2001)

Adjective Stability Rating	Bank Height Ratio
Stable (low risk of degradation)	1.0 – 1.05
Moderately unstable	1.06 – 1.3
Unstable (high risk of degradation)	1.3 – 1.5
Highly unstable	> 1.5

BHRs of 2.3 for Reach 1 and 3.3 for Reach 2 (Table 3.2) indicated the project reaches are deeply incised (Rosgen, 2006) and highly unstable Rosgen (2001). The deeply incised channel has very unstable banks and have very limited, if any, bank vegetation support throughout the project reaches.

The entrenchment ratio is measured as the width of the floodplain at twice the maximum bankfull depth. If the entrenchment ratio is less than 1.4, the stream is considered entrenched; if the entrenchment ratio is between 1.4 and 2.2, the stream is considered moderately entrenched; and above 2.2, the channel is considered slightly entrenched (Rosgen, 1996). Cross-sectional surveys showed Reach 1 is moderately entrenched and Reach 2 is entrenched (Table 3.2). Both reaches have experienced channelization and incision over the years. Reach 1 has also had time to laterally migrate causing a wider floodprone area that has filled in during channel migration across the valley; this would lead to a higher entrenchment ratio. Whereas, a portion of Reach 2 had recently been anthropogenically straightened, which steepened and deepened the profile, and therefore it was created as an incised and entrenched channel.

5.4 Biotic Assessment

5.4.1 Habitat

Stream habitat was assessed using the USEPA's *Rapid Bioassessment Protocols (RBP) for Use in Streams and Wadeable Rivers* (Barbour et al., 1999). The habitat assessment ranks ten different parameters on a scale of one to twenty with twenty being optimal. The scores of each parameter are totaled to provide a Habitat Assessment Value (HAV). This HAV assessment allows for the rapid assessment of in-stream characteristics, channel morphology, bank stability and riparian vegetation.

HAV scores for Schultz Creek ranged from 69 to 84, while Dry Fork had an HAV score of 101 (Appendix C). Habitat assessments indicate that overall the project reaches are deprived of in-stream aquatic habitat, having poor epifaunal substrate, an over abundance of sediment deposition, apparent channelization, and overall lack of riparian zone and immediate bank vegetation resulting in very unstable banks.

5.4.2 Benthic Macroinvertebrates

Benthic macroinvertebrates were sampled by KY Fish & Wildlife in July of 2009 using KDOW's *Methods for Assessing Biological Integrity of Surface Waters in Kentucky* (KDOW, 2002) in order to sample all representative habitats during both the baseline conditions. The same sampling methods will be applied during the monitoring to sample post-mitigation conditions. A multi-habitat approach was used to demonstrate the importance of habitat diversity for benthic macroinvertebrates. Monitoring of

existing streams typically results in a general lack of in-stream habitats, compared to the same streams after improvements, where in-stream habitat diversity has increased dramatically. By using a multi-habitat approach, the benthic macroinvertebrate data can demonstrate this change in available habitat.

A multi-habitat approach is conducted by collecting a composite sample of 3 jabs or sweeps using a D-frame dip net (0.5 m x 0.3 m) in each of the five (5) major, non-riffle habitats. Major habitat types (Undercut banks/root mats, Marginal emergent vegetation, bedrock or slab-rock, water willow beds, and leaf packs) were sampled within a 100 meter sampled reach, which is shown on Figure 1.2. Sampling began at the downstream end of the reach and proceeded upstream. The composite sample was washed through with on-site water, while large rocks and large woody debris were discarded. The sample was transferred to a 1-liter container and preserved with 95% ethanol.

All collected organisms were sorted and identified to family level. Identification followed Merritt and Cummins (1996) for larval insects and Pennak (1989) for crustaceans and annelids. Data analysis included calculation of RBP metrics: total taxa; Ephemeroptera/Plecoptera/Trichoptera (EPT) taxa; percent EPT; percent Chironomidae, percent two dominant taxa; and the modified Hilsenhoff Biotic Index (mHBI; Table 5.3). The family level index referred to as the KY Macroinvertebrate Bioassessment Index (fMBI; Pond, 2002; Table 5.4) will also be calculated and reported. The Simpson's Diversity index it a measurement that accounts for the richness and the percent of each species from a biodiversity sample within a local community (MSG, 2006). Simpson's Index (1 - D) is reported as the probability that two randomly selected individuals in a community belong to different categories.

Table 5.3
Modified Hilsenhoff Biotic Index (mHBI) Ranges (Mandaville, 2002; KDOW, 2002)

Biotic Index	Water Quality	Degree of Organic Pollution
0.00 – 3.50	Excellent	No apparent organic pollution
3.51 – 4.50	Very Good	Possible slight organic pollution
4.51 – 5.50	Good	Some organic pollution
5.51 – 6.50	Fair	Fairly significant organic pollution
6.51 – 7.50	Fairly Poor	Significant organic pollution
7.51 – 8.50	Poor	Very significant organic pollution
8.51 – 10.00	Very Poor	Severe organic pollution

Table 5.4
fMBI ranges (Pond, 2002)

Range	Rank
83 to 100	"Excellent"
72-82	"Good"
48-71	"Fair"
24 to 47	"Poor"
0 to 24	"Very Poor"

5.4.2.1 Schultz Sampling Station

The benthic macroinvertebrate data collected indicated overall good water quality, as 87% of the 179 individuals collected were EPT taxa. Overall diversity was excellent, as indicated by the Simpson's Diversity Index value of 0.821. The mHBI value of 2.2 indicated "Excellent" water quality, with no apparent organic pollution. The fMBI value of 65.3 was in the higher end of the "Fair" range; possibly an indication of habitat deficiencies (see Section 5.4.1) since overall water quality is well within recommended levels as prescribed by freshwater organisms (see Section 5.4.3).

Table 5.5
Benthic Macroinvertebrate Summary[1]

	# of Individuals	# of Taxa	% EPT	mHBI	fMBI	Simpson's Diversity
Schultz Creek	179	15	87	2.2	65.3	0.821

[1] based on family level identification

5.4.3 Water Quality

KY Fish & Wildlife collected basic water quality parameters for the mitigation project. Basic water quality parameters included pH and conductivity. Levels of pH were just below neutral, with values of 6.5 in Dry Fork and 6.6 in Schultz Creek. Conductivity levels were also low and well within recommended ranges for freshwater organisms, with values of 44 µS/cm in Dry Fork and 122 µS/cm in Schultz Creek.

6.0 MITIGATION CREDITS

The EKSAP was devised by interagency cooperation among the USACE, the U.S. Environmental Protection Agency (USEPA), the U.S. Fish and Wildlife Service (USFWS), the Kentucky Division of Water, and the KY Fish & Wildlife. The protocol combines the USEPA's Rapid Bioassessment Protocol (RBP) with macroinvertebrate population metrics to assess ecological integrity and fulfill requirements of Section 404 of the Clean Water Act in determining impacts and possible mitigation.

KY Fish & Wildlife applied the EKSAP on each of the restoration reaches located within the project area. The EKSAP provides an estimate of the ecological integrity of a headwater stream ecosystem relative to reference stream conditions in the same region. The output of the model is called the Ecological Integrity Index (EII) and ranges from 0.0 – 1.0. The EII is calibrated such that a score of 1.0 is given for stream conditions indicative of minimal disturbance or reference streams in the region. For each mitigation reach, the EII is multiplied by the stream length to provide a total of Ecological Integrity Units (EIUs).

The EKSAP shows that the restoration in Schultz Creek and its tributary will result in an overall increase of 110 linear feet and 1,260 EIUs.

Table 6.1
Proposed Mitigation Sites, EIU Summary

Reach	Pre-existing Conditions			Predicted Conditions			Functional Lift
	Length (ft)	EII	EIU	Length (ft)	EII	EIU	Difference in EIUs
Schultz Creek – Reach 1	582	0.55	320	583	0.97	566	246
Schultz Creek – Reach 2	2,109	0.55	1,160	2,167	0.97	2,102	942
Dry Fork	101	0.56	57	152	0.85	129	72
GRAND TOTAL	**2,792**	**N/A**	**1,537**	**2,902**	**N/A**	**2,797**	**1,260**

Notes: EII=Ecological Integrity Index (the output from the EKSAP model), EIU=Ecological Integrity Unit.

7.0 MITIGATION WORK PLAN

Section 7.0 describes the restoration design for Schultz Creek. The project reach was divided into two restoration reaches because of a change in drainage area (Figure 1.3). This restoration approach will restore a variety of hydrologic, hydraulic, geomorphic, aquatic, and terrestrial functions.

7.1 Potential for Restoration

The restoration approach for Schultz Creek considers the restoration potential, with the overall goal of improving impaired functions. The discussion below describes how the restoration design will improve geomorphology, hydrology and hydraulics, biotic conditions, and water quality in the restored reaches. Often, a design aspect can provide a functional lift for more than one function. For example, in-stream structures provide improved aquatic habitat, but also have a positive effect on geomorphology by providing bed and/or bank stability. In such cases, the discussion for the particular design aspect appears under the heading of the function that it has the greatest effect upon.

As shown in Section 3.0, the mitigation sites chosen for the project are appropriate candidates for restoration because the channel has greatly incised from past channelization, resulting in very poor bedform diversity, bank erosion, and poor in-stream habitat, as shown with the existing habitat assessment scores. Restoring proper pattern, profile, and dimension will stabilize the channel from further incision and aggradation, improve sediment transport function, increase floodplain functions, and improve bedform diversity and aquatic habitats, such as riffles and pools.

7.2 Design Rationale – Geomorphology

Specific design parameters were developed using a combination of reference reach data, evaluation of past projects, analytical models, and best professional judgment. A description of the design rationale is provided in this section for each of the project reaches. See the Project Plan Sheets (Appendix H) for detailed design information on the mitigation reaches.

7.2.1 Design Criteria

An undisturbed reference reach for dimension, pattern, and profile could not be found in close proximity to the project site. Therefore, instead, the design hydrology was examined by determining the bankfull discharge from regression equations from Kentucky (2003), Ohio (2005, 2003), and West Virginia (2003) and from nearby gage stations. The design bankfull discharges demonstrated that a smaller discharge was needed than the existing channel; a smaller discharge will lower shear stresses and erosion on the banks and bed. Once the design discharges were determined, the cross-sectional areas and width/depth ratios for both reaches were calculated in order to make sure that the design channel would have the appropriate competency to transport sediment (see Section 7.3.1). Once the cross-sectional areas, width/depth ratios, and sediment transport analyses were demonstrating stability, Baker was able to use an evaluation of past projects and compilation of reference reach data to create a set of design criteria for the design channels (C stream types). The results from this evaluation are shown in Table 7.1. These results represent an evaluation of a reference reach database published by the North Carolina Department of Transportation along with the evaluation of over twenty Baker projects, including six projects that have been monitored for over five years and have experienced two hurricanes.

Table 7.1
Design Criteria for C Stream Types

Parameter	Design Ratios	
	Minimum	Maximum
Stream Type (Rosgen)	C4	
Width to Depth Ratio	8.0	12.0
Riffle Max Depth Ratio	1.2	1.4
Bank Height Ratio	1.0	1.1
Meander Length Ratio	7.0	12.0
Rc Ratio	1.8	3.5
Meander Width Ratio	3.5	8.0
Sinuosity	1.2	1.6
Valley Slope Ratio	0.0050	0.0150
Riffle Slope Ratio	1.5	2.0
Run Slope Ratio	0.50	0.80
Glide Slope Ratio	0.30	0.50
Pool Slope Ratio	0.0	0.20
Pool Max Depth Ratio	2.0	3.5
Pool Width Ratio	1.3	1.7
Pool-Pool Spacing Ratio	4.0	7.0

7.2.1.1 Overview

Based on the existing condition survey, Schultz Creek has incised, overwidened, and aggraded resulting in a very unstable Rosgen F channel type. Upon review of the data and channel evolutionary processes, Schultz Creek will be designed as a stable Rosgen C stream type.

Selected design criteria are listed in Table 7.2. The design includes channel dimensions that only transport the bankfull discharge. All higher discharges will flow onto a restored floodprone area, providing storage for water and sediment. Although there is not much new channel pattern and profile design, those areas are designed to increase aquatic habitats and to create a diverse bedform of alternating riffle/steps and pools. Together, channel dimension, pattern, and profile are designed to create a channel that does not degrade or aggrade over time, while creating a variety of aquatic habitats.

In-stream structures will also be used to enhance the natural channel design. A combination of rock and log cross vanes, step pools, and rootwads will be used to provide grade control, improve bedform diversity, and re-introduce large woody debris. Erosion control matting, live stakes, bareroots, and transplants will be used to stabilize banks and facilitate a riparian buffer zone.

7.2.1.2 Dimension

The riffle cross-section was designed to carry the bankfull flow and to transport sediment delivered by the watershed. All flows greater than bankfull are transported on the adjacent floodplain. Sediment transport analyses indicated that the existing channel slope was too steep and the channel was too deep at bankfull flows, causing the channel to be degradational. In order to shallow the depth, a higher width to depth ratio was selected for design of the cross-section. Side slopes were set at a 2:1 slope to increase the width to depth ratio, lower the risk of erosion, and aid in the establishment of vegetation.

A bankfull width to depth ratio of 12 was selected so that proper slopes could be created along the riffle banks and to help achieve the appropriate depth for sediment transport competency and capacity.

The ratio of low bank height to maximum bankfull depth (BHR) will be set to 1.0. In areas along the mainstem channel where bank height might exceed bankfull stage because of localized topography or a low stream bed elevation, minimal grading will be used to transition bankfull stage to the floodplain. Once flood water rises above the bankfull stage, bankfull benches allow the storm flow to spread out on the floodplain and reduce erosion-causing shear stress in the channel. In-stream structures will be used to provide bank protection and maintain pool cross-sections throughout the channel, where necessary. Typical cross-sections are shown on the plan sheets (Appendix H).

7.2.1.3 Pattern

The proposed channel alignment will result in an overall increase in sinuosity from 1.10 to 1.20 and a 59-linear foot increase in length by re-routing the channel into its old remnant channel.

Meander width ratios for the project range from 3.3 to 8.0 times the bankfull width. Higher meander width ratios were incorporated into the design to lessen slope and decrease shear stress. Plan views of the channel are shown on the attached plan sheets (Appendix H).

Radii of curvature have been designed throughout the project to fall into the range of approximately 2.0 to 3.5 times the channel's proposed bankfull width. Radii of curvature in this range were chosen based on past project performance to minimize the risk of meander bend failure prior to vegetative root mass establishment while promoting the maintenance of preferred pool depth.

7.2.1.4 Profile/Bedform

Bedform will be diversified throughout the project through facet development (riffle, run, pool, glide, and step-pool) mimicking those characteristic of the reference reaches. The overall reach slope was designed to be appropriate for the channel type and to provide adequate sediment transport capacity and competency.

Riffles throughout the design reach are typically between 1.1 and 3.0 times the average slope of the channel. All elevation change will occur over the riffles and step structures; pools were designed with 0.0 to 0.2 percent slope to ensure constructability. Additionally, the longitudinal profile was optimized in conjunction with structure placement for aquatic habitat.

Table 7.2
Design Parameters and Proposed Geomorphic Characteristics

	Schultz Creek - Reach 1		Shultz Creek - Reach 2		Dry Fork
Parameter	MIN	MAX	MIN	MAX	
Drainage Area (sq mi)	9.5		13.4		3.8
Stream Type (Rosgen)	C4		C4		
Bankfull Discharge (cfs)	642		817		
Bankfull Riffle XSEC Area (sq ft)	140.0		185.0		70.0
Bankfull Mean Velocity (ft/s)	4.6		4.4		
Bankfull Riffle Width (ft)	41.0		47.1		29.0
Bankfull Riffle Mean Depth (ft)	3.4		3.9		1.9
Width to Depth Ratio (ft/ft)	12.0		12.0		12.0
Width Floodprone Area (ft)	90	205	104	--	
Entrenchment Ratio (ft/ft)	2.2	5.0	2.2	5.0	
Riffle Max Depth @ bkf (ft)	4.1	4.8	4.7	5.5	2.4
Riffle Max Depth Ratio	1.2	1.4	1.2	1.4	
Max Depth @ tob (ft)	4.1	4.8	4.7	5.5	
Bank Height Ratio (ft/ft)	1.0		1.0		
Meander Length (ft)	287	574	330	660	
Meander Length Ratio	7	14	7	14	
Radius of Curvature (ft)	74	144	85	165	
Rc Ratio	1.8	3.5	1.8	3.5	
Belt Width (ft)	143	328	165	377	
Meander Width Ratio	3.5	8.0	3.5	8.0	
Sinuosity	1.10		1.10		
Valley Slope (ft/ft)	0.0062		0.0053		
Channel Slope (ft/ft)	0.0056		0.0048		
Slope Riffle (ft/ft)	0.0068	0.0113	0.0058	0.0096	
Riffle Slope Ratio	1.2	2.0	1.2	2.0	
Slope Pool (ft/ft)	0.0000	0.0011	0.0000	0.0010	
Pool Slope Ratio	0.00	0.20	0.00	0.20	
Pool Max Depth (ft)	6.8	12.0	7.9	13.7	3.1
Pool Max Depth Ratio	2.0	3.5	2.0	3.5	
Pool Width (ft)	53.3	69.7	61.3	80.1	37.0
Pool Width Ratio	1.3	1.7	1.3	1.7	
Pool Width/Depth Ratio	7.8	5.8	7.8	5.8	19.5
Pool Area (ft/ft)	182.0	280.0	240.5	370.0	70.1
Pool Area Ratio	1.3	2.0	1.3	2.0	
Riffle Length (ft)	41.0	123.0	47.1	141.4	
Riffle Length Ratio (ft)	1.0	3.0	1.0	3.0	
Pool-Pool Spacing (ft)	164.0	287.0	188.5	329.8	
Pool-Pool Spacing Ratio	4.0	7.0	4.0	7.0	
d16 (mm)	29.0		29.0		
d35 (mm)	40.0		40.0		
d50 (mm)	51.0		51.0		
d84 (mm)	110.0		110.0		
d95 (mm)	200.0		200.0		

7.3 Design Rationale – Hydrologic & Hydraulics

7.3.1 Sediment Transport Analyses

Sediment transport competency and capacity were assessed for the proposed typical cross-sections of Schultz Creek. Sediment transport competency is a stream's ability to mobilize particles of a particular size, and sediment transport capacity is the stream's ability to move a certain volume of particles over a specific duration of time. When designing natural channels to carry the bankfull discharge, the particle size used for this analysis is the largest particle collected from a sub-pavement sample (material that is immediately beneath the bed veneer) or the largest particle from a point bar (Rosgen, 2001). Results from the sediment transport competency analysis are shown below in Table 7.3.

7.3.1.1 Sediment Transport Competency

The ability of a stream to transport the available bed material is important for creating a stable channel that displays stable bed forms such as riffles, pools, runs, and glides. These bed features are an integral aspect of the overall stream function and help to support aquatic life such as macro-invertebrates and fish. In addition, balanced sediment transport will allow the stream to reach a dynamic equilibrium in which major aggradation or degradation does not occur (i.e., the stream has the competency and capacity to transport available sediment without causing erosion).

Baker used an in-house entrainment spreadsheet similar to USEPA WARSSS Worksheet 27 (2005) in order to compute sediment transport for the existing and proposed design cross-sectional geometries for the two reaches along Schultz Creek. Reach 1 illustrated that the existing shear stress was approximately 0.75 lb/ft^2 and the design shear stress was to be 1.19 lb/ft^2. Reach 2 illustrated that the existing shear stress was approximately 0.71 lb/ft^2 and the design shear stress was to be 1.17 lb/ft^2. Both reaches show an increase in shear stresses from the existing condition to the proposed design. The increase is needed in order to transport the bed material through the existing overly wide aggradational reaches.

The largest particle diameter that can be mobilized at the bankfull flow was determined for Reaches 1 and 2 to be 300 mm and 295 mm, respectively (USEPA, 2005; Table 7.3). Comparing these values to the D_{84} and D_{100} particle sizes shown in Table 7.3 reveals that the proposed stream reaches will mobilize the D_{100} particle size for both reaches. The design had the goal of mobilizing the D_{100} particles, since the existing reaches exhibit that they should be able to transport the D_{84} particles, which was not the case with the excessive aggradation.

Based on the competency analysis, it appears that the proposed channel is properly sized with the appropriate slope to transport sufficient bed material sizes during the bankfull event. Sizing the channel to only entrain the material that needs to be transported to prevent aggradation or degradation helps create stable bedforms, such as riffles, runs, pools, and glides, that support aquatic life such as macro-invertebrates and fish.

Table 7.3
Sediment Transport Competency Analysis

Stream Reach/Cross-section	Calculated Shear Stress (lb/ft^2)		Grain Diameter of Largest Particle Mobilized (mm)		Existing Grain Diameter (mm)	
	Existing	Proposed	Existing	Proposed	D_{84}	D_{100}
Schultz Creek - Reach 1	.75	1.19	190	300	110	274
Schultz Creek – Reach 2	.71	1.17	182.5	295	110	274

7.4 Design Rationale – Biotic

The biotic functions of a stream system are highly influenced by the structural form of the stream channel itself. Aquatic organisms are suited to specific habitats, and with more diversity of habitats there is generally an increased diversity of aquatic organisms (i.e., a higher functional level). Natural, stable stream systems develop this diversity over time, through processes such as sediment transport, bed material sorting, organic matter collection, and vegetation growth. When stream systems become impaired, biotic functions are typically impaired.

In restored stream systems, newly constructed channels must be built in a way that ensures stability while also providing appropriate and diverse habitats. Stream channels are constructed to provide riffle, pool, and transition areas, with structural components to provide stability and habitat value. As the system matures over time, the restored stream will function more and more as a natural system, with biotic functions approaching those of reference sites.

7.4.1 In-Stream Structures

In-steam structures are used in restoration design to provide channel stability and promote certain habitat types. In-stream structures are necessary because newly constructed channels do not have dense riparian vegetation and roots that provide bank stability, nor do they exhibit a natural distribution of stream bed material that provides armoring and allows stable sediment transport processes. In-stream structures are used to provide stability to the system until these natural processes evolve to provide long-term stability and function to the system (see Table 7.4).

The proposed mitigation plan calls for installing a variety of different structures including, but not limited to, those described in Table 7.4. Specific locations of in-stream structures in each of the mitigation sites are presented on the attached plan sheets (Appendix I).

Table 7.4
Proposed In-Stream Structure Types and Locations

Structure Type	Location
Root Wads	Outer meander bends and other areas of concentrated shear stresses and flow velocities along banks.
Cross Vanes	Long riffles; tails of pools if used as a step; areas where the channel is overly wide; areas where stream gradient is steep and where grade control is needed.
Single Vanes and J-hooks	Outer meander bends; areas where flow direction changes abruptly; areas where pool habitat for fish species is desirable.
Cover Logs	Used in pools where habitat for fish species is desirable.
Root Wads	Outer meander bends and other areas of concentrated shear stresses and flow velocities along banks.
Log Weirs or steps	Riffles / steps of smaller streams.
Rock Step Pools	Riffles / steps of smaller streams.

7.4.1.1 Root Wads

Root wads are placed at the toe of the stream bank in the outside of meander bends and other areas of concentrated shear stresses along stream banks for the creation of habitat and for bank protection. Root wads include the root mass or root ball of a tree plus a portion of the trunk. They are used to armor a stream bank by deflecting stream flows away from the bank. In addition to stream bank protection, they provide structural support to the stream bank and habitat for fish and other aquatic animals. Banks underneath rootwads tend to become slightly undercut,

forming an area of deep water, shade, and cover for a variety of fish species. Organic debris tends to collect on the root stems that reach out into the channel, providing a food source for numerous macroinvertebrate species. Root wads will be placed throughout the mitigation project.

7.4.1.2 Cross Vanes

Cross vanes are used to provide grade control, keep the thalweg in the center of the channel, and protect the stream bank. A cross vane consists of two rock or log vanes joined by a center structure installed perpendicular to the direction of flow. This center structure sets the invert elevation of the stream bed. Cross vanes are typically installed at the tails of riffles or pools or within riffle sections to provide convergence and redirect flows away from streambanks. Cross vanes are also used where stream gradient becomes steeper, such as the downstream end of a small tributary that flows into a large stream.

Scour pools form downstream of cross vanes, because of the increased flow velocity and gradient. Pool depth will depend on the configuration of the structure, the flow velocity and gradient, and the bed material of the stream. For many fish species, these pools form areas of refuge because of the increased water depth and prime feeding areas provided as food items are washed into the pool from the riffle or step directly upstream.

7.4.1.3 Single Vanes and J-Hooks

Vanes are most often located in meander bends just downstream of the point where the stream flow intercepts the bank at acute angles. Vanes may be constructed out of logs or rock boulders. The structures turn water away from the banks and re-direct flow energies toward the center of the channel. In addition to providing stability to streambanks, vanes also promote pool scour and provide structure within the pool habitat. J-hooks are vane structures that have two to three boulders placed in a hook shape at the upstream end of the vane. The boulders are placed with gaps between them to promote flow convergence through the rocks and increased scour of the downstream pool. Because of the increased scour depths and additional structure that is added to the pool, J-hooks are primarily used to enhance pool habitat for fish species. The boulders that cause flow convergence also create current breaks and holding areas along feeding lanes. The boulders also tend to trap leaf packs and small woody debris that are used as food sources for macroinvertebrate species.

7.4.1.4 Cover Logs

A cover log is placed in the outside of a meander bend to provide cover and enhanced habitat in the pool area. The log is buried into the outside bank of the meander bend; the opposite end extends through the deepest part of the pool and may be buried in the inside of the meander bend, in the bottom of the point bar. The placement of the cover log near the bottom of the bank slope on the outside of the bend encourages scour in the pool, provides cover and ambush locations for fish species, and provides additional shade. Cover logs are often used in conjunction with other structures, such as vanes and rootwads, to provide additional structure in the pool.

7.4.2 Vegetation

Native riparian and streamside vegetation will be established in the constructed buffer areas. Also, areas of invasive and introduced vegetation, such as Japanese knotweed (*Polygonum cuspidatum*) and/or multiflora rose (*Rosa multiflora*), will be managed so that the newly-established native plants within the riparian buffer zones will not be threatened.

7.4.2.1 Stream Buffer Vegetation

Bare-root trees, live stakes, and permanent and temporary seeding will be planted within designated areas of the restoration. A minimum 25-foot buffer on each stream side will be

established or enhanced along all restored stream reaches. In many areas, the natural buffer width will be in excess of 100 feet. In general, bare-root vegetation will be planted at a target density of 450 stems per acre. Planting of bare-root trees and live stakes will be conducted during the dormant season, with all trees installed prior to March 31. Depending on the seedings, plantings will occur between November and April (winter wheat and winter rye or perennial rye) at a rate of 130 pounds per acre or between April and August (brown top millet) at a rate of 40 pounds per acre.

Species selection for re-vegetation of the site will generally follow those suggested by Strausbaugh & Core (1978) and native species suggestions for West Virginia using the NRCS's Conservation Plant Database (USDA NRCS, 2007). Selected species for hardwood re-vegetation are presented in Table 7.5. Tree species selected for stream restoration areas will be generally weak to tolerant of flooding. Weakly tolerant species are able to survive and grow in areas where the soil is saturated or flooded for relatively short periods of time. Moderately tolerant species are able to survive in soils that are saturated or flooded for several months during the growing season. Flood tolerant species are able to survive on sites in which the soil is saturated or flooded for extended periods during the growing season. Species selection may change due to availability of species at the time of planting, however, any deviations from plant lists must be preapproved by the proper regulatory agencies.

Table 7.5
Bare-Root Trees Species Selected for Revegetation of the On-Site Mitigation Areas

Stream Banks (Live Stakes)			
Silky dogwood	*Cornus obliqua*	40%	65 to 100 stems per 1,000 SF
Silky willow	*Salix sericea*	40%	65 to 100 stems per 1,000 SF
Elderberry	*Sambucus canadensis*	20%	33 to 50 stems per 1,000 SF
Stream Riparian Buffer (Bare Root Trees)			
River birch	*Betula nigra*	30%	140 stems per acre
Tulip poplar	*Liriodendron tulipifera*	30%	140 stems per acre
Sycamore	*Platanus occidentalis*	20%	85 stems per acre
Southern red oak	*Quercus rubra*	20%	85 stems per acre
Alternate Species			
Silky Cornel	*Cornus amomum*		
Black Willow	*Salix nigra*		
Ninebark	*Physocarpus opulifolius*		

Observations will be made during construction of the site regarding the relative wetness of areas to be planted. Planting zones will be determined based on these observations, and planted species will be matched according to their wetness tolerance and the anticipated wetness of the planting area.

Once trees are transported to the site, they will be planted within two days. Soils across the site will be sufficiently disked and loosened prior to planting. Trees will be planted by manual labor using a dibble bar, mattock, planting bar, or other approved method. Planting holes for the trees will be sufficiently deep to allow the roots to spread out and down without "J-rooting." Soil will be loosely compacted around trees once they have been planted to avoid drying out.

Live stakes will be installed randomly two to three feet apart using triangular spacing or at a density of 160 to 360 stakes per 1,000 square feet along the stream banks between the toe of the stream bank and the bankfull elevation. Site variations may require slightly different spacing. The live stake must be installed at a depth so that only 20 percent of the stake is exposed to sunlight, with a minimum of two lateral buds exposed.

A mixture is provided for streambank and stream riparian buffer areas. Mixtures will also include temporary seeding (winter wheat and winter rye or perennial rye) to allow for application with mechanical broadcast spreaders. Permanent seed mixtures will be applied to all disturbed areas of the project site. Table 7.6 lists the species, mixtures, and application rates which will be used. The permanent seed mixture specified for floodplain areas will be applied to all disturbed areas outside the banks of the restored stream channel and is intended to provide rapid growth of herbaceous ground cover and biological habitat value. The species provided are deep-rooted and have been shown to proliferate along restored stream channels, providing long-term stability. Species selection may change due to availability of species at the time of planting, however, any deviations from plant lists must be preapproved by the proper regulatory agencies.

Table 7.6
Permanent Seed Mixtures for Revegetation

Floodplain and Buffer Areas				
Virginia wildrye	*Elymus virginicus*	25%	2	FAC
Switchgrass	*Panicum virgatum*	25%	3	FAC+
Fox sedge	*Carex vulpinoidea*	25%	3	OBL
Redtop	*Agrostis alba*	25%	2	FAC
Restored Streambanks				
Virginia wildrye	*Elymus virginicus*	30%	12	FAC
Switchgrass	*Panicum virgatum*	30%	3	FAC+
Soft rush	*Juncus effusus*	20%	2	FACW+
Deertongue	*Dichathelium Clandestinum*	20%	12	FACW
Alternate Species				
Rice Cutgrass	*Leesia oryzoides*			
Wood Reed-Grass	*Cinna arundinacea*			

A mixture of the permanent seeding for restored streambanks and the temporary seeding will be applied to all disturbed areas of the site that are susceptible to erosion. These areas include constructed streambanks, access roads, side slopes, and spoil piles. A combination of both seeding types should be applied from November through April and applied at a rate of 50 pounds per acre. Species selection may change due to availability of species at the time of planting, however, any deviations from plant lists must be preapproved by the proper regulatory agencies.

7.4.2.2 Invasive Species Removal

To reduce the immediate threat and minimize the long-term potential of degradation, no identified invasive or introduced species will be planted in the mitigation sites. For instance, invasive or introduced species, such as but not limited to annual rye grass, timothy, weeping lovegrass, reed canary grass, white clover, orchard grass, foxtail millet, autumn olive, kudzu, European black alder, and red clover will not be used. Only plant materials native and indigenous to the region shall be used. Vegetation monitoring will be conducted biannually during the five year

monitoring period. Any natural invasion of such species detected during the five year monitoring period will be removed and/or controlled using either manual, chemical, or mechanical control efforts.

7.5 Design Rationale – Water Quality

Design considerations for the improvement of water quality in the restoration reaches focused on increased aeration, shading, and the addition of organic matter. These functional lifts are a result of a natural channel design which addresses stream dimension, pattern, and profile, placement of rock and wood in-stream structures and planting of riparian vegetation. These design options are described in Section 7.4. In addition to providing functional lifts, the design will make alterations that reduce sediment both from upland and in-stream sources and enhance stream bank stability.

Water quality monitoring of impaired streams and the quantification of improvements through restoration requires substantial amounts of data collected over many years, both before and after restoration. Therefore, developing design criteria from site specific water quality monitoring is not practical. Instead, a thorough review of the literature was used as a guide to create a natural channel design that will ultimately improve water quality. The following discussion provides background information on the likely functional improvements associated with the natural channel design.

7.5.1 Sediment

Stream restoration projects are probably most often instigated to address obvious and chronic erosion and sedimentation problems. Geomorphic modifications and the placement of structures are often guided by the need to alter existing forces and situations that are causing stream banks to become unstable. Sediment is recognized by most if not all states as the worst pollutant of our nation's waterways. In his extensive review of the literature dealing with sediment in streams, Waters (1995) states, "After a half-century of the most rigorous research, it is now apparent that fine sediment, originating in a broad array of human activities, overwhelmingly constitutes one of the major environmental factors—perhaps the principal factor—in the degradation of stream fisheries."

Sediment is an insidious pollutant because it is natural for streams to carry a certain amount of sediment. In fact, a stream bed that is heterogeneous in terms of sediment sizes will support the greatest diversity of insects (Minshall, 1984). However, when the "normal" amount or size of sediment changes it begins to degrade the aquatic environment. Sediment is considered a pollutant when the quantity and quality is unnatural. When this occurs, the impact on all aquatic organisms in a stream system can be significant.

Three streams in the Piedmont ecoregion of North Carolina that differed in terms of land use within their drainages, being either forested, agricultural, or urbanized, were compared (Lenat and Crawford, 1994). The forested stream differed from the other two streams which had similar water quality. Suspended sediment yield was greatest for the urban stream and least for the forested stream. Storm flows showed a similar pattern, but suspended sediment concentrations were highest from the agricultural stream on low to moderate flows. Invertebrate sampling indicated that the agricultural stream was at a moderate stress level and that the urban site had severe stress. Lemly (1982) examined the effects of inorganic sediment and nutrient enrichment on the benthic insect community of a southern Appalachian trout stream. Pollutants entered the stream at different points allowing an assessment of how sediment alone and sediment in association with nutrient enrichment impacted insect communities. Diversity and biomass of certain species were significantly reduced in the polluted zones. Sediment's filling interstitial spaces and thereby disrupting feeding was considered to be the primary factor affecting filter feeding taxa. Inorganic sediment directly affected stream insects by accumulating on body surfaces and respiratory structures. In the zone of nutrient enrichment, particle laden insects were also observed to have growths of filamentous bacteria. Thus, sediment and nutrient enrichment operated synergistically to eliminate a significantly greater number of stream insect taxa. Richards et

al. (1993) sampled macroinvertebrate community composition in streams of a large Michigan watershed. Benthic communities of streams where agriculture was a primary land use were the most different from other streams. Substrate characteristics were the most important variable for explaining variation in benthic communities. Significant correlations were observed between substrate quality and the total numbers of Ephemeropteran, Plecopteran, and Trichopteran (EPT) taxa. This supports using EPT taxa as an indicator of stream quality.

There is a wide body of information on the effects of sediment on fish, particularly cold water species. Waters (1995) provides an extensive review of these studies. Sediment limits transfer of dissolved oxygen to incubating salmonid eggs. Cederholm et al. (1980) examined the effects of siltation from logging roads on salmonid spawning success. They found that the survival of eggs to emergence was inversely correlated with the proportion of fines when the percentage of fines exceeds the natural level of ten percent. With every one percent increase in fines, there is a rapid decline in survival to emergence. Binns (2004) analyzed wild trout abundance, biomass and habitat prior to and after 30 habitat enhancement projects by the state of Wyoming. Trout biomass and abundance increased for most of the projects. Cover for trout and pool depth significantly increased, and erosion from stream banks significantly decreased. The influence of sediment on fish reproductive success varies with the reproductive guild of the fish (Balon, 1975). Species that depend on clean stony substrates to deposit their eggs suffer the greatest impacts, and species that have floating eggs or that guard and clean their eggs will have the least impact. Sediment can also bury fish cover and habitat. Branson and Batch (1972) reported that some fish species were eliminated from a Kentucky stream by mining activities that deposited clay sediments on the bottom of the stream to a depth of two to six inches.

Even amphibian populations have been shown to be affected by excessive sediment moving in a stream. Corn and Bury (1989) studied one species of frog and three species of salamanders in 43 streams in Oregon. Twenty-three were in forested watersheds and twenty were in watersheds that had been cut within 14 to 40 years of the study. Streams that were in the cut areas had greater deposits of sediment within the stream and had a smaller substrate particle size. All four amphibian species had higher densities and biomass in the uncut watersheds. Investigators attributed the difference to loss of interstitial spaces that the larvae of these species need for proper development.

Restoring a stream to its proper dimension, pattern, and profile will create a channel that moves water and sediment through the reach without causing aggradation or degradation. The purpose of stream restoration using a natural channel design approach is to evaluate what geomorphology the channel needs to avoid having erosion or depositional problems. Common adjustments that restore stream stability might include developing a meandering pattern to increase stream length and reduce stream slope, adjusting the cross-section to provide good habitat while moving sediment through the reach, and installing stream structures that protect eroding stream banks by reducing near bank shear stress.

The most common reason that stream banks become unstable and cause sedimentation of the stream is that the land adjoining the stream has been used in such a way that riparian woody vegetation is significantly diminished or eliminated. This inevitably results in unstable stream banks that erode at the bank toe; and when erosion has caused sufficient loss of support, the bank slumps. To mitigate this problem trees are planted to reestablish a stable stream bank. Wynn et al. (2004) found that at depths greater than 30 cm forested riparian sites had significantly greater fine and small root length density than did herbaceous sites. Since the greatest shear stress is at the toe of the stream bank, and since erosion at the toe most often causes bank failures, trees should be planted along banks to protect the toe. Trees will produce a root system that will grow to a depth that allows the fine and small roots to bind with the soils, increasing the soil critical shear stress (Gray and Leiser, 1982). Dunaway et al. (1994) found that the erosion rate was inversely proportional to root volume. Therefore, restoration projects that enhance or reestablish woody vegetation along stream banks significantly reduce the likelihood of bank failure and sedimentation of the stream.

As demonstrated by this information, sediment significantly impacts the ability of aquatic organisms to survive and grow in a lotic environment. Stream restoration centers on understanding and manipulating erosional and depositional processes, using abiotic and biotic structure. Successful restoration will result in a stream carrying a natural sediment load that promotes species diversity and health.

8.0 MAINTENANCE PLAN

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established, woody floodplain vegetation are more susceptible to erosion from floods than those with a mature, hardwood forest.
- Projects with sandy, non-cohesive soils are more prone to short-term bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with wide floodplains are less vulnerable than confined channels.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive species can affect the extent to which a native buffer can be established.

Maintenance issues and recommended remediation measures will be detailed and documented in the as-built and monitoring reports.

9.0 PERFORMANCE STANDARDS AND MONITORING REQUIREMENTS

Monitoring will be conducted in order to 1) document project successes, and 2) identify failures for which a contingency or long term management plan must be implemented. Channel stability, stream functions, benthic macroinvertebrates, and vegetation survival will be monitored along each mitigation reach for a minimum of five years following the completion of construction. Table 9.1 provides a list of each component that will be measured during monitoring along with the criteria used to determine success with each component. It should be noted that biotic standards are contingent upon water quality parameters' remaining within recommended ranges for freshwater organisms.

Table 9.1
Success Criteria and Monitoring Actions

Type/Category	Criteria	Year 1	Year 2	Year 3	Year 4	Final Value (after 5 years)
Geomorphology	BEHI (Max)	High (Below 35)		Moderate (Below 30)		Low (Below 20)
	Sediment Production From Banks (bankpins or cross-sections)	Report annual sediment production from banks	Report annual sediment production from banks	Report annual sediment production from banks	Report annual sediment production from banks	Mean sediment production from banks less than 0.5 feet/year over years 3-5
	Stable banks and channel (photos)*	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually	Assessed visually for instability. Photograph documentation annually. W/D ratio will not increase by more than 1.2 from design criteria, BHR will be less than 1.2, ER will be less than 1.4.
Hydrology	Crest gage or observation	Report greater than bankfull flows	At least 1 BKF event recorded	At least 1-2 cumulative BKF events recorded	At least 1-2 cumulative BKF events recorded	At least 3 cumulative BKF events recorded
Vegetation	Min % Trees Native	90%	90%	90%	90%	90%
	Max % Trees Non-native	10%	10%	10%	10%	10%
	Max.% Trees Invasive	10%	10%	10%	10%	10%
	Max % Invasive plants (herbaceous or woody)	10%	10%	10%	10%	10%
	Min. Native Stem Density per acre	150	150	150	300	300
	Maximum Percent any one tree Species	50%	50%	50%	35%	25%
	Species List (Scientific &	Yes	Yes	Yes	Yes	Yes

Type/Category	Criteria	Year 1	Year 2	Year 3	Year 4	Final Value (after 5 years)
	Common Name, Wetland Status Indicator, Native vs. Non-Native vs. Invasive)					
Habitat	USEPA RBP	Total score = 145		Total score = 150		Total score > 155
Biotic*	KDOW Methods (benthic macroinvertebrates)	Spring sample; year 1		Spring sample; year 3		Spring sample; year 5. *Equivalent or higher metrics and values than baseline conditions*

*RBP biotic metric will not be used to determine project success/failure, but goals have been set for year 5

9.1 Photograph Documentation

Photographs will be used annually to evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures subjectively. Lateral photos should not indicate excessive erosion or continuing degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation.

Reference stations will be photographed before construction and continued for a minimum of five years following construction or until such mitigation is deemed successful. Reference photos will be taken once a year. Photographs will be taken from a height of approximately five to six feet. Permanent markers will be established to ensure that the same locations (and view directions) on the site are documented in each monitoring period.

The water line will be located in the lower edge of the frame, and as much of the bank as possible will be included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

9.2 Geomorphology & Hydrology Success Criteria

Geomorphic monitoring and success criteria of restored stream reaches will be conducted for a minimum of five years to evaluate the effectiveness of the mitigation practices. The related success criteria are described below for each monitored parameter.

9.2.1 Bankfull Events

The occurrence of bankfull events within the monitoring period will be documented by the use of water level gages and photographs. A crest gage will be installed along each mitigation reach and will record the stream water level. Photographs will be used in addition to the water level gage to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

A cumulative of three bankfull flow events must be documented by year five of the monitoring period or monitoring must extend until such time as the three cumulative events have occurred. The purpose of monitoring bankfull events is to document that out-of-bank flows and an active floodplain have been restored as part of the mitigation work.

9.2.2 BEHI

Bank erosion hazard index (BEHI) scores will be collected in each of the restored channels. BEHI scores were also collected prior to initiation of mitigation. Success will be achieved by demonstrating a Low BEHI score at the end of the five year monitoring period. If scores are not met, remedial actions may be necessary (Table 9.1).

9.3 Vegetation Success Criteria

Successful restoration of the vegetation on a stream mitigation site is dependent upon hydrologic restoration, active planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria have been met, vegetation monitoring quadrants will be permanently installed across the mitigation site. The number of quadrants required will be based on the species/area curve method, as described in monitoring guidance documents (Starr et al.; 2001). The size of individual quadrants is 100 square meters for woody tree species and 1 square meter for herbaceous vegetation. Individual quadrant data will be provided and will include diameter, density, and coverage quantities. Individual seedlings will be marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

The measure of vegetative success for the site will be the control of exotic and invasive species and will be monitored biannually between July and November during the five year monitoring period. No more than 10 percent of the final percent cover (excluding grasses) shall include the exotic woody, vine, and forb plant species that are on the Kentucky Exotic Pest Plant Council's Sever Threat and Significant Threat lists. Of the 10 percent allowable invasive trees, honeysuckle and Osage orange are excluded. Specific success criteria of each of these criteria are outlined in Table 9.1. For instance, it is projected that 90 percent of the percent cover of vegetation is native species five years after planting, as well as, throughout the monitoring period is required to determine success. Additionally, no more than 10% of the total percent cover shall be herbaceous cover and no more than 5% of the percent cover shall be woody or vine species in the stem counts. All trees and shrubs will be selected based upon their hydrologic and edaphic tolerances, wildlife food and cover value and will be native to the area.

9.4 Habitat Success Criteria

Specific and measurable success criteria for habitat will include comparison of the average habitat assessment value (HAV) collected prior to initiation of mitigation and those collected after mitigation. The final success criteria will be achieved by demonstrating the total HAV scores will be greater than 155 at the end of the five year monitoring period (Table 9.1). Specific success criteria of each of these criteria are outlined in Table 9.1. For instance, HAV scores shall total 145 after year 1, 150 after year 3, and 156 after year 5. If the year 5 score is not met after year 5, remedial actions may be necessary (Table 9.1). During the year 1 through 4 monitoring period, if scores are not being met, a contingency plan will need to be developed and implemented.

9.5 Biotic Success Criteria

9.5.1 Benthic Macroinvertebrates & Water Quality

Biotic assessments were conducted prior to the initiation of mitigation. After construction, biotic monitoring will be conducted during the spring sampling season during year one, year three, and year five following construction. Baseline water chemistry parameters will be collected with each biotic sampling event. Field pH, conductivity, dissolved oxygen, temperature, and measured discharge will also be collected during the benthic macroinvertebrate monitoring.

Specific and measurable success criteria for benthic macroinvertebrates will include comparison of the benthic macroinvertebrate metrics and values to baseline conditions. The final success criteria will be the achievement of scores being equal or greater than the initial pre-construction scores at the end of the five year monitoring period.

9.6 Reporting Methods

An as-built survey documenting post-construction conditions will be conducted within 60 days of the completion of planting on the mitigation sites and the corresponding report will be submitted to the USACE and the Kentucky Division of Water (KDOW) with the year one monitoring report. The monitoring reports will include all information required by the USACE; Regulatory Guidance Letter dated August 3, 2006 (USACE, 2006). The monitoring program will be implemented to document system development and progress toward achieving the success criteria referenced in the previous sections. Stream morphology, hydrology, and vegetation, will be assessed to determine the success of the mitigation. The monitoring program each year will be initiated after the first growing season and continue for a minimum of five years, or until the final success criteria are achieved (Section 9.1). Monitoring reports will be prepared each year of monitoring and submitted to the USACE and KDOW by December 31 each year. The monitoring reports will include:

- A detailed narrative summarizing the condition of the mitigation site and all regular maintenance activities;
- As-built topographic maps showing location of monitoring stations, vegetation sampling plots, permanent photo points, and location of transects;
- Total linear feet of mitigation, the construction EIUs, revised debit/credit tables;
- Photographs showing views of the mitigation site taken from fixed-point stations;
- Hydrologic information;
- Vegetative data including species identified and any maintenance activities with invasive species;
- Identification of any invasion by undesirable plant species, including quantification of the extent of invasion of undesirable plants by either stem counts, percent cover, or area, whichever is appropriate;
- Biotic data;
- A description of any damage done by animals or vandalism;
- Wildlife observations; and
- Reference hydrology and stream data.

9.7 Release from Monitoring

Once the project has been monitored for a minimum of five years and has met the annual success criteria, KY Fish & Wildlife shall request, in writing, release from monitoring. The request shall include a minimum of the following items:

1) Final Monitoring Report, including an evaluation of project success and final success criteria metrics;
2) Final credits based on project success;
3) Jurisdictional determinations for any created waters of the U.S.; and
4) Any other items deemed necessary.

The USACE shall conduct a final site visit and notify KY Fish & Wildlife in writing whether release from monitoring is deemed appropriate or what additional information, corrective measures, or additional monitoring are necessary for the USACE to approve monitoring release.

10.0 LONG TERM MANAGEMENT

A post-mitigation monitoring period has been discussed in Section 9.0 of this plan. In the event that successful mitigation of jurisdictional waters cannot be achieved, KY Fish & Wildlife proposes to conduct repair, corrective, and/or maintenance throughout the project site during the five year monitoring period. For instance, if HAV scores are not being met during the initial monitoring years, a contingency or long term management plan must be developed and implemented to meet those predicted HAV scores. If any failures are noticed, KY Fish & Wildlife will contact the USACE and KDOW for approval before implement of a contingency or long term management plan to repair, correct, or maintain the mitigation site.

10.1 Maintenance Issues

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established, woody floodplain vegetation are more susceptible to erosion from floods than those with a mature, hardwood forest.
- Projects with sandy, non-cohesive soils are more prone to short-term bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with wide floodplains are less vulnerable than confined channels.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive species can affect the extent to which a native buffer can be established.

Maintenance issues and recommended remediation measures will be detailed and documented in the as-built and monitoring reports. The conditions listed above and any other factors that may have necessitated maintenance will be discussed.

11.0 ADAPTIVE MANAGEMENT

With the application of adaptive management, this mitigation plan is intended to survive well beyond the planning horizon, remaining viable and vital to any future planning efforts throughout the watershed.

The concept of adaptive management acknowledges the dynamic nature of natural systems and the changing state of knowledge and developing management strategies. Adaptive management involves acknowledging new information and making objective judgments regarding whether to change strategies to better achieve management objectives. If new information indicates an alternative strategy is effective, the plan should provide the flexibility and allow the latitude to pursue it. It is very difficult to predict what adjustments might be necessary in the future.

Additions or changes to this mitigation plan will occur only with the approval of the regulatory agencies, aside from specific structure locations or slight field modifications during construction which will be documented and professionally certified in the final as-built surveys. In order to keep the plan document current and relevant, the following items will be reviewed on a regular basis to determine whether or not a revision to the plan is warranted:

- Changes to resource permitting requirements.
- Monitoring data from on-going programs.
- Other newly reported data coming to KY Fish & Wildlife's attention.
- Reassessment of specific goals and whether or not they have been met.

12.0 FINANCIAL ASSURANCES

KY Fish & Wildlife is financially secure with regards to its ability to complete all required jurisdictional waters restoration activities, including all necessary post-mitigation maintenance and monitoring. KY Fish & Wildlife is financially secure to provide remedial actions if needed. The holder of the conservation easements will ensure that current and future property owners have the resources to manage and protect the site in accordance with the conditions set forth in the easement documents.

13.0 DISCLAIMER

This project was assembled at the client's request by Michael Baker Jr., Inc. using data and information provided by KY Fish & Wildlife. The scope of this study was mutually devised by Michael Baker Jr., Inc. and the client, and it is limited to the specific project, location, and time period described herein.

Michael Baker Jr., Inc. assumes no responsibility for information provided or developed by others or for documenting conditions detectable with methods or techniques not specified in the work scope. Michael Baker Jr., Inc. has reviewed the information provided by others and found it to be credible for the purpose of this report.

This report is intended for the use of the designated client within a reasonable period of time from its issuance. Michael Baker Jr., Inc. also has not independently verified information furnished by other parties included in this report and therefore cannot warrant the accuracy, completeness, legality, reliability, or efficacy of such information. However, Michael Baker Jr., Inc. has deemed this information to be credible at the time of issuance of this report, and therefore its use is considered to be judicious. Conclusions derived from this report are subject to revision if unverified data is demonstrated after issuance of this report to be incomplete or inaccurate, there are modifications to the data, or there emerges significant new data. Unauthorized or unintended use of this report or the information contained herein shall indemnify Michael Baker Jr., Inc. from any and all injury, damage, and liability arising from such use. This disclaimer applies to both partial and aggregate uses of this report.

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Figures

1.0 SECTION 1

2.0 SECTION 2

N/A

3.0 SECTION 3

4.0 SECTION 4

N/A

5.0 SECTION 5

1.0 SECTION 1

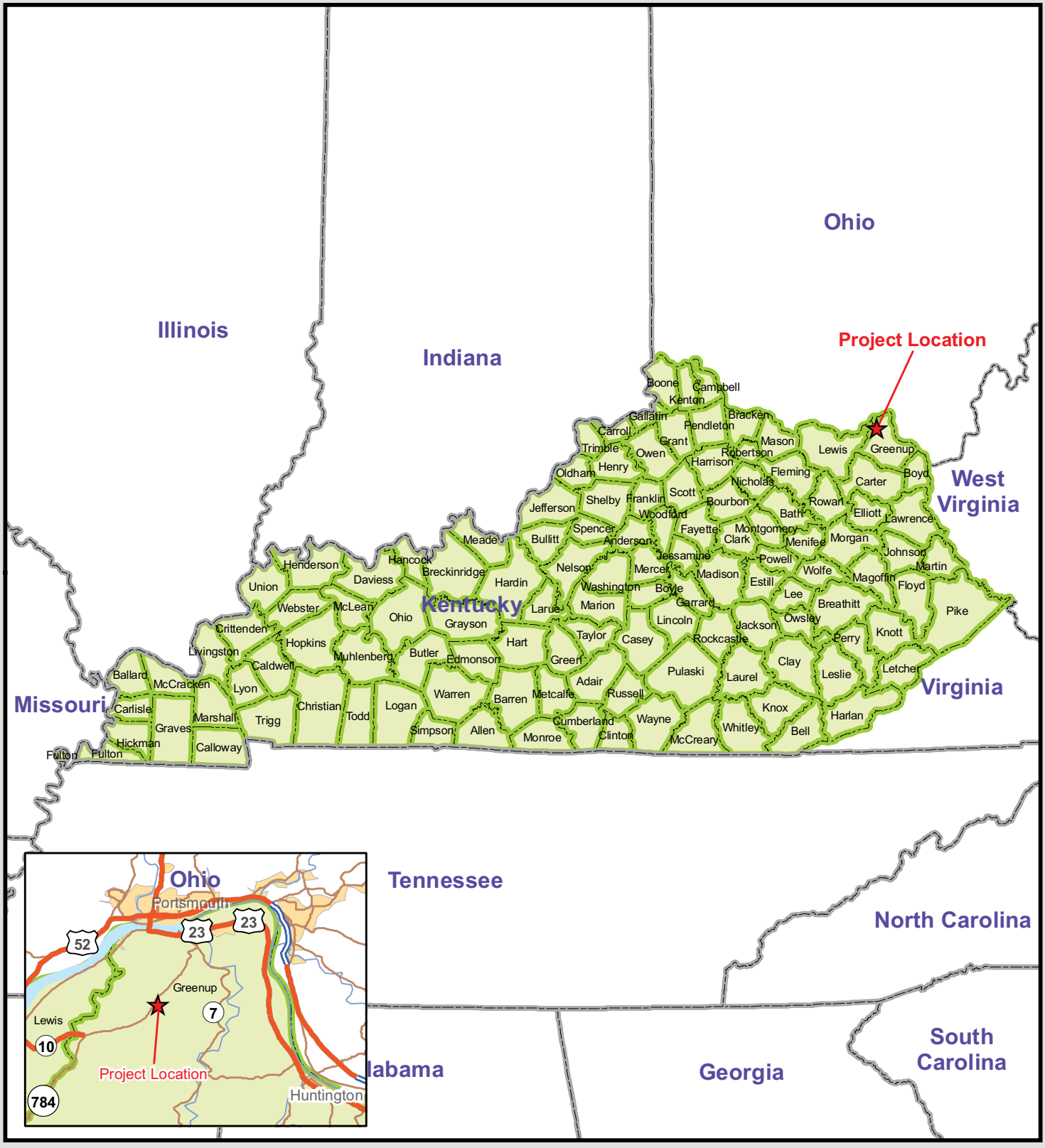

FIGURE 1.1 - PROJECT LOCATION MAP

60 0 60 Miles

90 45 0 90 Kilometers

N W E S

Baker

Kentucky Department of Fish and Wildlife Resources
1 Sportsman's Lane
Frankfort, KY 40601
800-858-1549

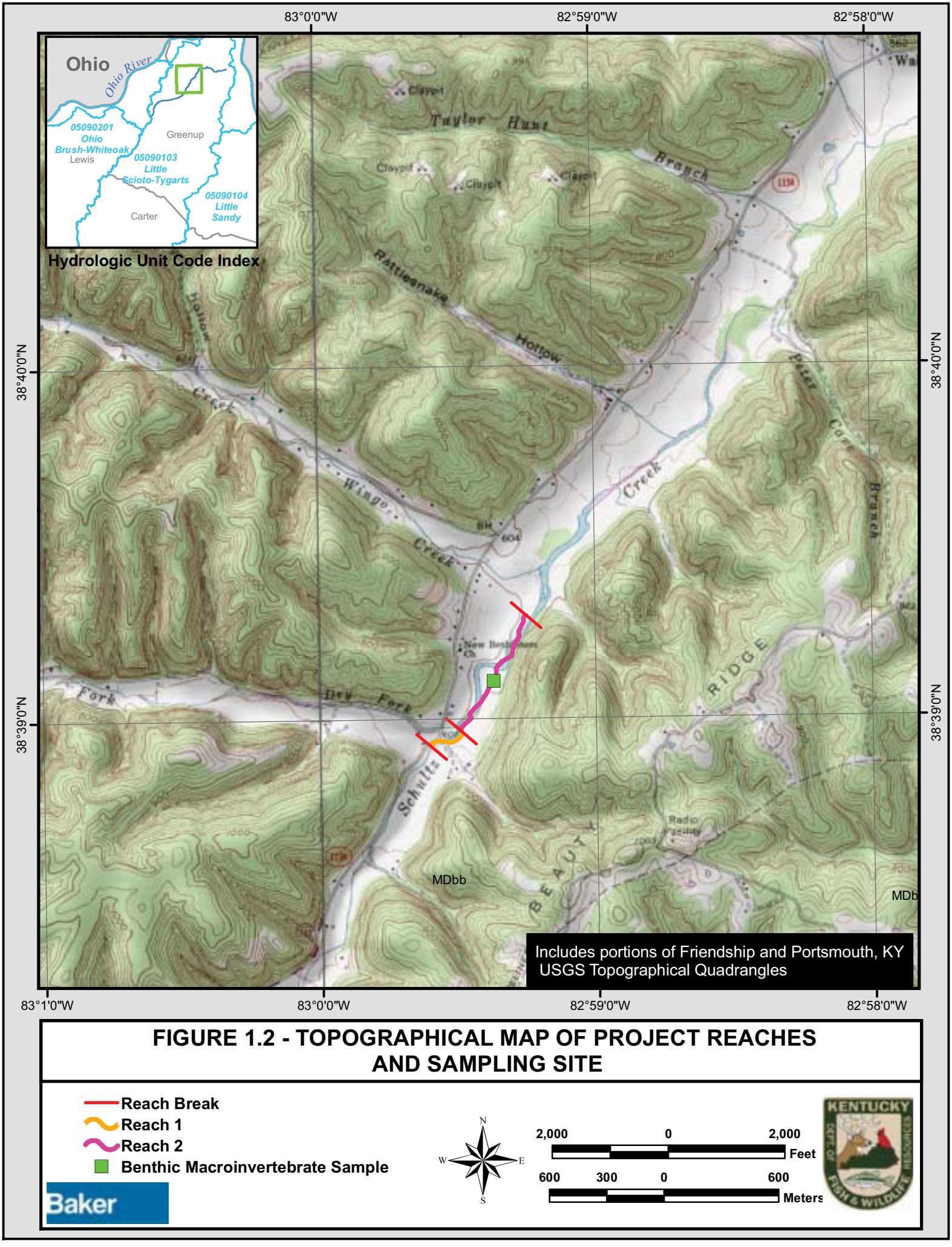

FIGURE 1.2 - TOPOGRAPHICAL MAP OF PROJECT REACHES AND SAMPLING SITE

- Reach Break
- Reach 1
- Reach 2
- Benthic Macroinvertebrate Sample

N W E S

2,000 0 2,000 Feet

600 300 0 600 Meters

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KENTUCKY FISH & WILDLIFE RESOURCES

FIGURE 1.3 - AERIAL MAP OF PROJECT REACHES

Reach Break
Reach 1
Reach 2

N
W E
S

500 0 500 Feet

150 75 0 150 Meters

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KENTUCKY DEPT OF FISH & WILDLIFE RESOURCES

3.0 SECTION 3

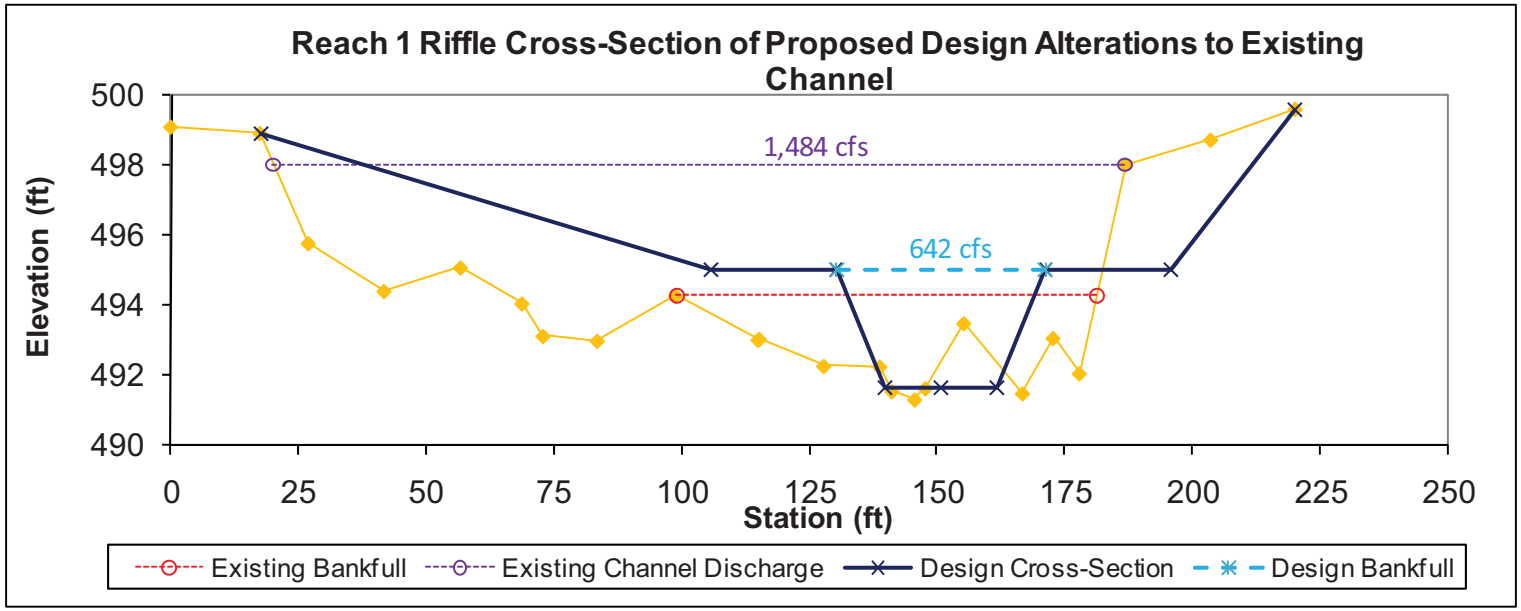


Figure 3.1 Comparison of Existing Channel and Design Channel Discharge for Reach 1

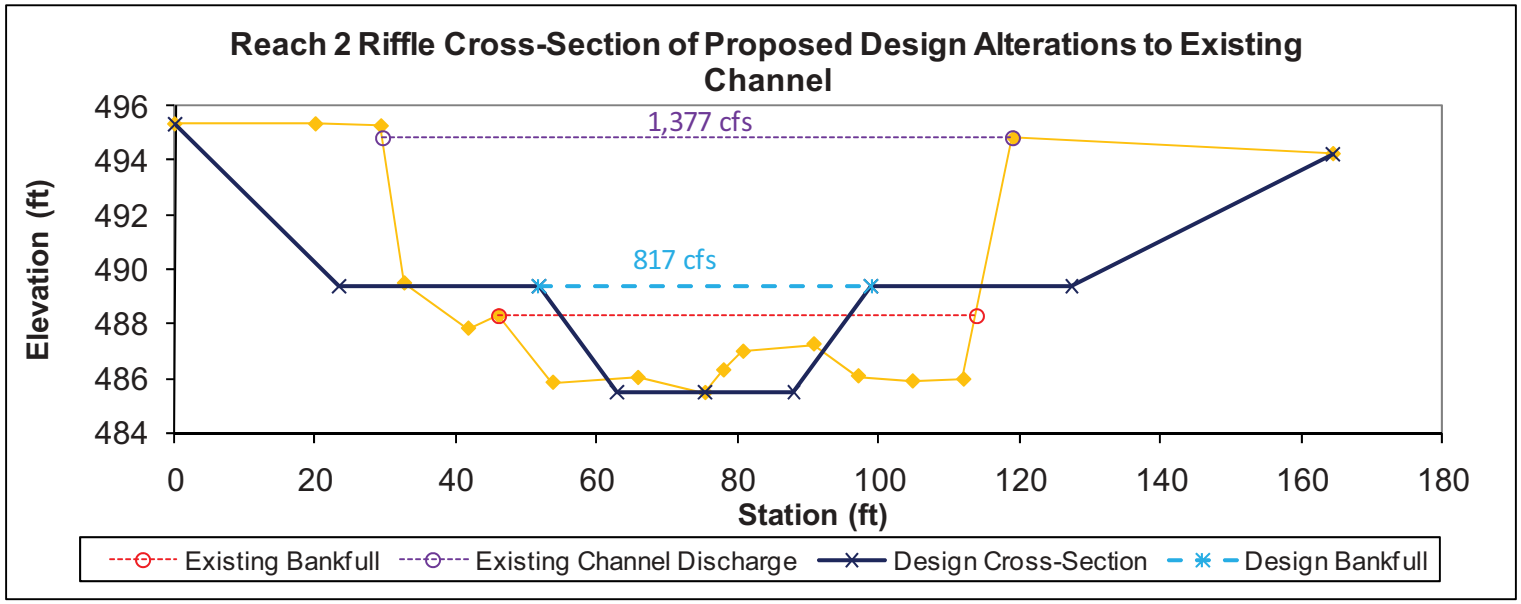


Figure 3.2 Comparison of Existing Channel and Design Channel Discharge for Reach 2

5.0 SECTION 5

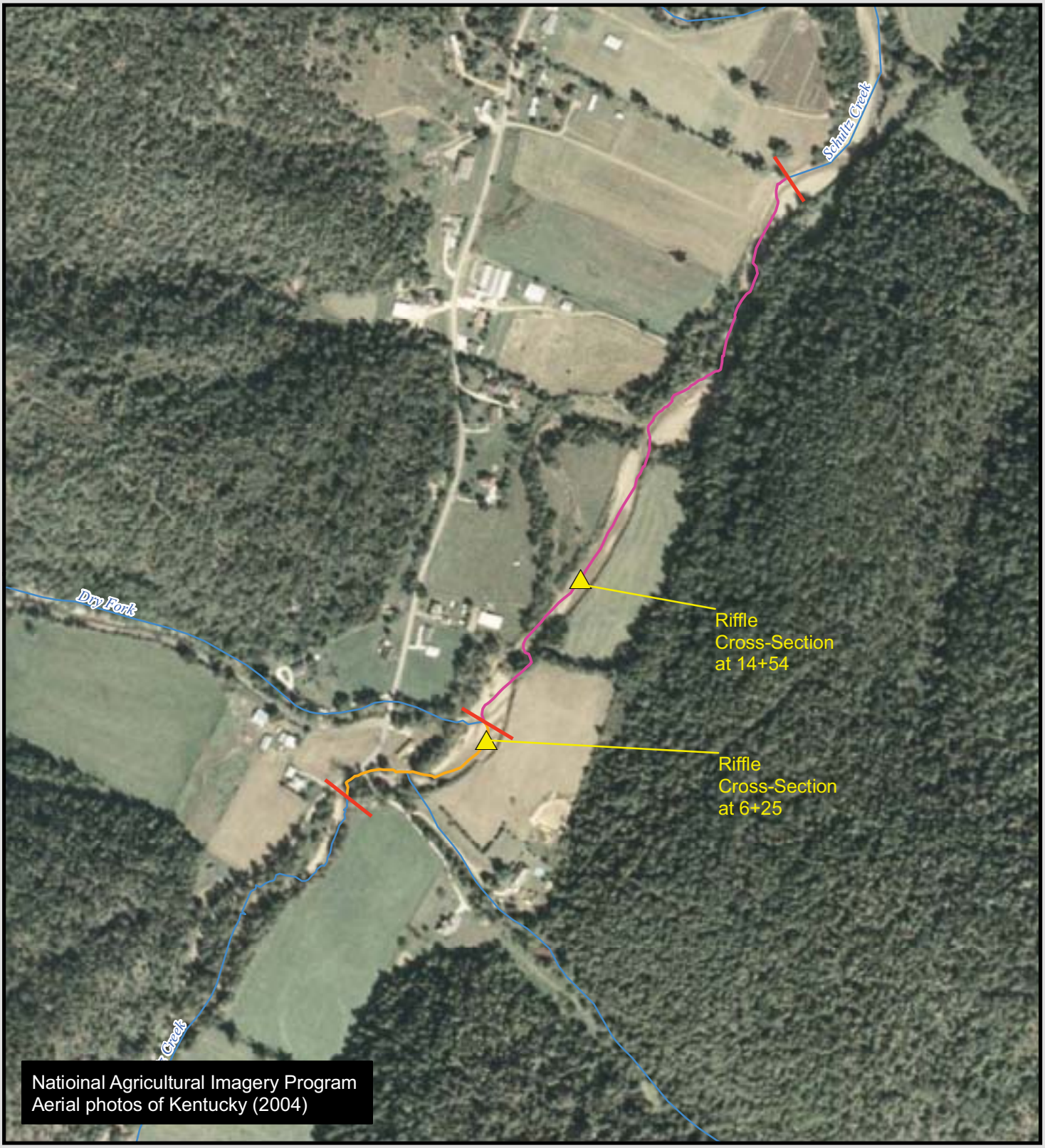


FIGURE 5.1 - AERIAL MAP OF REACH CROSS-SECTIONS

Reach Break
Reach 1
Reach 2
Riffle Cross-Section

N
W
E
S

500 0 500 Feet

150 75 0 150 Meters

Baker

KENTUCKY DEPT OF FISH & WILDLIFE RESOURCES

List of Appendices

APPENDIX A

BA CONCURRENCE LETTER

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

June 15, 2009

Mr. Mike Hardin
Kentucky Department of Fish and Wildlife Resources
#1 Sportsman's Lane
Frankfort, KY 40601

Subject: FWS #2008-B-0187, Shultz Creek, Proposed Stream Restoration and Enhancement, Greenup County, Kentucky

Dear Mr. Hardin:

We received your letter dated May 22, 2009 and the enclosed Biological Assessment (BA) prepared for the proposed Shultz Creek Restoration Project. This project involves the restoration and enhancement of approximately 2,800 linear feet of stream on Shultz Creek in Greenup County, Kentucky.

We have reviewed the submitted BA for the Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*), fanshell mussel (*Cyprogenia stegaria*), pink mucket (*Lampsilis abrupta*), ring pink (*Obovaria retusa*), rough pigtoe (*Pleurobema plenum*), purple catspaw pearlymussel (*Epioblasma o. obliquata*), sheepnose (*Plethobasus cyphyus*) and clubshell (*Pleurobema clava*).

Regarding the Indiana bat, the BA states that there is a lack of potential winter/swarming habitat within the action area and that direct impacts to summer habitat will be avoided by removing trees only during the period when Indiana bats are expected to be absent from the area (October 15 through March 31). Additionally, the project site is 20.1 miles from the nearest designated critical habitat (Bat Cave, Carter County). Best management practices will be employed during construction to minimize any sediment impacts associated with the construction of the stream restoration project.

The proposed project will not impact any known or potential gray bat roosting habitat. Although there may be temporary negative impacts to gray bat foraging habitat during the construction of the stream restoration project, these impacts will be minimized through the implementation of sediment and erosion control measures and other best management practices. Long-term, the restored stream and riparian zone should improve foraging habitat for the gray bat.

The proposed project will not directly impact any known or potential habitat for the fanshell mussel (*Cyprogenia stegaria*). Any potential indirect impacts to habitat downstream of the proposed project caused by the construction of the restoration project will be temporary and minimized by the implementation of sediment and erosion control measures and a Storm Water Pollution Prevention Plan. Long-term, the restoration of this reach of stream should result in improved water quality through habitat stabilization, reduced bed and bank erosion and restoration of the riparian zone.

Regarding the pink mucket (*Lampsilis abrupta*), ring pink (*Obovaria retusa*), rough pigtoe (*Pleurobema plenum*), purple catspaw pearlymussel (*Epioblasma o. obliquata*), sheepnose (*Plethobasus cyphyus*) and clubshell (*Pleurobema clava*), the proposed project is outside of the known range of these species and suitable habitat is not present within the area influenced by the proposed project.

After evaluating on the submitted information we concur with the not likely to adversely affect determination for the Indiana bat, gray bat and fanshell mussel and with the no effect finding on the pink mucket, ring pink, rough pigtoe, purple catspaw pearlymussel, sheepnose, clubshell and critical habitat for the Indiana bat.

Based on these determinations and our concurrences with them, we believe that the requirements of section 7 have been fulfilled as it relates to federally listed species listed in the BA.

Obligations under section 7 must be reconsidered, however, if:

(1) New information reveals that the proposed project may affect listed species or proposed critical habitat in a manner or to an extent not previously considered,

(2) The proposed project is subsequently modified to include activities which were not considered during this consultation, or

(3) New species are listed or critical habitat designated that might be affected by the proposed project.

If you need additional assistance in determining if a proposed project may impact a federally listed species, we recommend that you contact us for further assistance. Thank you for the opportunity to comment on this proposed action. If you have any questions regarding the information which we have provided, please contact Jennifer Garland at (502) 695-0468 extension 115.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor

APPENDIX B

SHPO CONCURRENCE LETTER

STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

MARCHETA SPARROW
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

MARK DENNEN
EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

May 13, 2009

Ms. Christy Mower
Michael Baker Jr. Inc.
5088 West Washington Street
Charleston, WV 25313

Re: Schultz Creek Stream Restoration, Greenup County, Kentucky - Kentucky Fish and Wildlife

Dear Ms. Mower:

We have reviewed the information provided regarding the above-mentioned report. The project will take place mostly within the existing overly wide creek channel. The creek will be rerouted into the old remnant channel and the slope of some banks will be reworked. Because the project is taking place within the remnant creek channel, no archaeological survey is necessary. However, should construction plans change to include any additional ground disturbance at new locations or should any type of artifact be discovered during re-channeling , this office should be notified immediately to determine if any additional documentation is necessary.

Should you have any questions, feel free to contact Lori Stahlgren of my staff at (502) 564-7005, extension 151.

Sincerely,

Mark Dennen, Executive Director
Kentucky Heritage Council and
State Historic Preservation Officer

LCS/lcs

APPENDIX C

EKSAP

PRE-EXISTING CONDITIONS

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Schultz Reach 1 Pre-existing

Assessment Objectives: Create an Ecological Lift by implementing stream restoration & enhancement techniques

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.55	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	7	no units	
3. Velocity/Depth Regime	12	no units	
4. Sediment Deposition	6	no units	
5. Channel Flow Status	6	no units	
6. Channel Alteration	11	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	4	no units	
Total Habitat Score	84	no units	Subindex
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness		# of taxa sampled	
12. Family EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. mFBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	122	microMHOs	1.00

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Schultz Reach 2 Pre-existing

Assessment Objectives: Create an Ecological Life by implementing stream restoration and enhancement techniques

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.55	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	6	no units	
2. Embeddedness	6	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	3	no units	
5. Channel Flow Status	7	no units	
6. Channel Alteration	11	no units	
7. Freq. Of Riffles (bends)	6	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	6	no units	
10. Riparian Width (both combined)	4	no units	
Total Habitat Score	69	no units	Subindex
Habitat Integrity Index			0.10
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness		# of taxa sampled	
12. Family EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. mFBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	122	microMHOs	1.00

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Dry Fork of Schultz Pre-existing

Assessment Objectives: Create an Ecological Lift by implementing stream restoration & enhancement techniques

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.56	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	10	no units	
2. Embeddedness	9	no units	
3. Velocity/Depth Regime	10	no units	
4. Sediment Deposition	7	no units	
5. Channel Flow Status	9	no units	
6. Channel Alteration	13	no units	
7. Freq. Of Riffles (bends)	7	no units	
8. Bank stability (both combined)	10	no units	
9. Veg. Protection (both combined)	12	no units	
10. Riparian Width (both combined)	14	no units	
Total Habitat Score	101	no units	Subindex
Habitat Integrity Index			0.11
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness		# of taxa sampled	
12. Family EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. mFBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	43.8	microMHOs	1.00

PREDICTED CONDITIONS

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Schutlz Reach 1 Predicted

Assessment Objectives: Create an Ecological Lift by implementing stream restoration & enhancement techniques

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.97	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	15	no units	
2. Embeddedness	16	no units	
3. Velocity/Depth Regime	12	no units	
4. Sediment Deposition	18	no units	
5. Channel Flow Status	19	no units	
6. Channel Alteration	19	no units	
7. Freq. Of Riffles (bends)	19	no units	
8. Bank stability (both combined)	18	no units	
9. Veg. Protection (both combined)	18	no units	
10. Riparian Width (both combined)	12	no units	
Total Habitat Score	166	no units	Subindex
Habitat Integrity Index			0.93
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness		# of taxa sampled	
12. Family EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. mFBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	122	microMHOs	1.00

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Schultz Reach 2 Predicted

Assessment Objectives: Create an Ecological Lift by implementing stream restoration & enhancement techniques

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.97	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	15	no units	
2. Embeddedness	16	no units	
3. Velocity/Depth Regime	12	no units	
4. Sediment Deposition	18	no units	
5. Channel Flow Status	19	no units	
6. Channel Alteration	19	no units	
7. Freq. Of Riffles (bends)	19	no units	
8. Bank stability (both combined)	18	no units	
9. Veg. Protection (both combined)	18	no units	
10. Riparian Width (both combined)	12	no units	
Total Habitat Score	166	no units	Subindex
Habitat Integrity Index			0.93
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness		# of taxa sampled	
12. Family EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. mFBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	122	microMHOs	1.00

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Dry Fork of Schultz Predicted

Assessment Objectives: Create an Ecological Lift by implementing stream restoration & enhancement techniques

EII	Model
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)
0.85	Ecological Integrity Index (Habitat Integrity + Conductivity)

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	14	no units	
2. Embeddedness	15	no units	
3. Velocity/Depth Regime	15	no units	
4. Sediment Deposition	16	no units	
5. Channel Flow Status	16	no units	
6. Channel Alteration	16	no units	
7. Freq. Of Riffles (bends)	10	no units	
8. Bank stability (both combined)	18	no units	
9. Veg. Protection (both combined)	18	no units	
10. Riparian Width (both combined)	14	no units	
Total Habitat Score	152	no units	Subindex
Habitat Integrity Index			0.70
Macroinvertebrate Data - Family Level (All Habitats)			
11. Family Taxa Richness		# of taxa sampled	
12. Family EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. mFBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	43.8	microMHOs	1.00

SITE GAINS

Comparison of Ecological Integrity Indices and Units
(Preproject vs Postproject Conditions)

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Schultz Creek Reach 1

Assessment Objectives: Create an Ecological Life by implementing stream restoration & enhancement techniques

	EII	Project Length	EIU
Preproject	0.55	582	320
Postproject	0.97	583	566

Net Loss = **NA**

Net Gain = **245.41**

* Enter data generated from the Ecological Integrity Calculation spreadsheet into the gray shaded boxes.
**NA = Nonapplicable

Comparison of Ecological Integrity Indices and Units
(Preproject vs Postproject Conditions)

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Schultz Creek Reach 2

Assessment Objectives: Create an Ecological Life by implementing stream restoration & enhancement techniques

	EII	Project Length	EIU
Preproject	0.55	2109	1160
Postproject	0.97	2167	2102

.

Net Loss = **NA**

Net Gain = **942.04**

* Enter data generated from the Ecological Integrity Calculation spreadsheet into the gray shaded boxes.
**NA = Nonapplicable

Project ID: Schultz Creek Enhancement & Restoration Project

Stream/Reach: Dry Fork of Schultz Creek

Assessment Objectives: Create an Ecological Life by implementing stream restoration & enhancement techniques

	EII	Project Length	EIU
Preproject	0.56	101	57
Postproject	0.85	152	129

Net Loss = **NA**

Net Gain = **72.64**

PROJECT GAINS

Comparison of Ecological Integrity Units

(Functions Lost Due to Project Impacts vs Functions Gained through Mitigation)

Project ID: Schultz Creek Enhancement & Restoration Project
Watersheds: Schultz Creek Watershed

	EIUs
Project Losses	0
Mitigation Gains	1260

Net Loss = NA

Net Gain = 1260

* Enter data generated from the Reach Gains or Losses spreadsheet into the gray shaded boxes.
**NA = Nonapplicable

Explanation of Results:

APPENDIX D

PRELIMINARY JURISDITCIONAL DETERMINATION

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD):

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
Kentucky Department of Fish & Wildlife Resources

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Louisville Office

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION:
The project is located parallel to Route 784, 1.3 miles north of the Route 10 junction, in northern Greenup County. Driving directions are as follows: from Interstate 64, take exit 172 and travel north onto Route 9 towards Vanceburg. Approximately three miles before Vanceburg, turn right onto Route 10. Approximately five miles past Lewis/Greenup County line turn left on Route 784 and travel approximately 1.3 miles on Route 784 to the site.

The project area encompasses a portion of Schultz Creek, which has been determined to be perennial. The project area also encompasses a portion of an intermittent tributary to Schultz Creek named Dry Fork. The project area is within the Hydrologic Unit Code (HUC) 05090103 (Little Scioto-Tygarts), as identified by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). The portion of Schultz Creek upstream of the mouth of Dry Fork is referred to herein as Reach 1, while the portion of Schultz Creek downstream of Dry Fork is Reach 2. Reach 1 currently extends 582 linear feet, and Reach 2 currently extends 2,109 linear feet, and Dry Fork currently extends 101 linear feet into the project area.

(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State: KY County/parish/borough: Greenup City: Letitia
Center coordinates of site (lat/long in degree decimal format): Lat. 38.654722° N, Long. 82.987222° W
Universal Transverse Mercator: 4280335.4 N 327082.1E
Name of nearest waterbody: Ohio River, Traditional Navigable Water

Identify (estimate) amount of waters in the review area:
Non-wetland waters: 2,900 linear feet: 97.2 average width (ft) and/or 7.6 (stream) acres.
Cowardin Class: NA
Stream Flow: Perennial
Wetlands: NA acres.

Cowardin Class: NA

Name of any water bodies on the site that have been identified as Section 10 waters:

Tidal: NA

Non-Tidal: NA

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:

☐ Field Determination. Date(s):

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement

action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable. This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: Michael Baker Jr., Incorporated

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.

☐ Office concurs with data sheets/delineation report.

☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps: .

☐ Corps navigable waters' study: .

☐ U.S. Geological Survey Hydrologic Atlas: .

☐ USGS NHD data.

☒ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name: Scale 1:1000. Portsmouth Quad.

☒ USDA Natural Resources Conservation Service Soil Survey. Citation: United States Department of Agriculture (USDA). 2007. Soil Survey of Menifee and Rowan Counties, West Virginia. United States Department of Agriculture, Soil Conservation Service, Washington DC.

☐ National wetlands inventory map(s). Cite name: .

☐ State/Local wetland inventory map(s): .

☐ FEMA/FIRM maps: .

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date): 2006, NAIP .

or ☒ Other (Name & Date):LIDAR, December 2007.

☐ Previous determination(s). File no. and date of response letter: .

☐ Other information (please specify): .

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

_____	_____
Signature and date of Regulatory Project Manager (REQUIRED)	Signature and date of person requesting preliminary JD (REQUIRED, unless obtaining the signature is impracticable)

Table 1. Summary information for Item D in Background Information.

Site number	Latitude	Longitude	Cowardin Class or Flow Regime	Estimated amount of aquatic resource in review area	Class of aquatic resource
1. Schultz Creek	38.654722 N	82.987222 W	Perennial	2,749 linear feet	RPW-Seasonal
2. Dry Fork	38.649444 N	82.991389 W	Intermittent	152 linear feet	RPW-Seasonal

APPENDIX E

EASEMENT DOCUMENTS

DEED OF CONSERVATION EASEMENT

THIS DEED OF CONSERVATION EASEMENT is entered into by and between Ishmel Howard (hereinafter "Grantor") and the Department of Fish and Wildlife Resources, for and on behalf of the Commonwealth of Kentucky (hereinafter "Grantee").

WITNESS THAT:

WHEREAS, the Grantor is the landowner of certain real property (hereinafter "Project Area") located in Greenup County, Kentucky, and more particularly described in the "Project Area Description" attached hereto and incorporated herein as Exhibit A; and

WHEREAS, the Project Area will be improved by creating better access to a floodplain, bank stabilization, establishment of riparian zone, and creating better aquatic habitat; and

WHEREAS, the remainder of the Project Area remains in a substantially undisturbed, natural state and has significant value as stream habitat; and

WHEREAS, the Grantee is a governmental body empowered to hold an interest in real property under the laws of the Commonwealth of Kentucky and the United States and, therefore, qualifies as a holder pursuant to KRS 382.800; and

WHEREAS, both Grantor and Grantee desire to retain and protect the natural, scenic, and open-space values of the Project Area, and assure the Project Area's availability for agricultural, forest, recreational, and open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, or cultural aspects of the Project Area; and

WHEREAS, KRS 382.800 through KRS 382.860 permits the creation of conservation easements for the purposes of, inter alia, retaining land or water areas predominantly in their natural, scenic, open or wooded condition or as suitable habitat for fish, plants, or wildlife and to insure that the areas will be available for agricultural, forest, recreational, educational, or open-space use; and

NOW, THEREFORE, in consideration of the mutual covenants contained herein; and further, pursuant to KRS 382.800 through 382.860, Grantor does hereby convey to Grantee a Conservation Easement (hereinafter "Easement") in perpetuity over the Project Area to be held for the benefit of the people of the Commonwealth of Kentucky and consisting of the following:

(1) The Project Area shall be maintained in perpetuity for the following purpose:

stream habitat

(2) Grantee shall manage the Project Area in strict accordance with:

(a) KRS Chapter 150

(b) KRS 382.800 through 382.860, and

(c) The detailed channel design plan pertaining to the Project Area which has been generated by the Grantee.

(3) The Grantee has the right of visual access to and view of the Project Area in its natural, scenic, open and undisturbed condition.

(4) The Grantee has the right to enter the Project Area, in a reasonable manner and at reasonable times, for the purposes of inspecting the same to determine compliance with this Easement.

(5) There shall be no removal, destruction, cutting, trimming, mowing, alteration, or spraying with biocides of any vegetation, nor any disturbance or change in the natural habitat within the Project Area in any manner unless addressed in the final design plan or specifically authorized by the Grantee.

(6) There shall be no planting or introduction of any species of vegetation within the Project Area unless addressed in the final design plan or specifically authorized by the Grantee.

(7) There shall be no harvesting of timber within the Project Area unless addressed in the final design plan or specifically authorized by the Grantee.

(8) There shall be no commercial or industrial activity undertaken or allowed within the Project Area, nor shall any right of passage across or upon the Project Area be allowed or granted if that right of passage is used in conjunction with commercial or industrial activity. (KRS 382.800(1) clearly references agricultural usage.)

(9) Grantor shall be allowed to remove trash and debris from the Project Area.

(10) Except as deemed necessary by the Grantee in completing the channel design plan, there shall be no filling, excavation, or dredging within the Project Area.

(11) There shall be no mining or drilling within the Project Area.

(12) There shall be no removal of topsoil, sand, gravel, rock, minerals or other materials within the Project Area.

(13) There shall be no dumping of ashes, trash, garbage, or any other material within the Project Area.

(14) There shall be no changing of the topography within the Project Area in any manner.

(15) There shall be no construction or placing of temporary or permanent buildings, mobile homes, advertising signs, billboards, or other advertising material, or other structures within the Project Area.

(16) Except with the written consent of the Grantee, there shall be no building of new roads, trails, or other rights of way within the Project Area. Existing trails and roads may be maintained by reasonable means consistent with the purposes of this Easement.

(17) There shall be no introduction of non-native wildlife as defined by 301 KAR 2:081 and 301 KAR 1:122 into the Project Area without the written consent of the Grantee. (Plants are covered in paragraph 6.)

(18) Except as deemed necessary by the Grantee in completing the channel design plan, there shall be no damming, dredging or construction in any free-flowing water body, nor construction of any weirs, groins, or dikes in any wetlands, or any manipulation or alteration of natural water courses, fresh water lake or pond shores, marshes, wetlands, or other water bodies nor any activities or uses detrimental to water purity within the Project Area.

(19) Except as deemed necessary by the Grantee in completing the channel design plan , there shall be no operation of mechanical or motorized vehicles within the stream channel, not including designated crossings. Mechanical or motorized vehicles shall cross perpendicular to the channel, as opposed to, driving the vehicle up and down the length of the stream.

(20) Where applicable, there shall be no destruction of fencing placed within the Project Area. After the five-year monitoring period the Grantor agrees to maintain the fence in a condition that is at a minimum that with which it was received from the Grantee.

(21) Any use of the Project Area or any activity thereon which, in the opinion of the Grantee, is or may become inconsistent with the purpose of this Easement, which is the preservation of the area in its natural and undisturbed condition for the purposes set out in KRS 382.800(1) and the management and protection of its environmental systems, is prohibited.

(22) In the event of a violation of any term, condition, or restriction contained in this Easement, the Grantee may immediately enforce any of the remedies including but not limited to those set forth in KRS 382.990. Any failure by the Grantee to avail itself of these remedies shall not be deemed to be a waiver or forfeiture of the right to enforce any term, condition, covenant of purpose of this Easement.

(23) This Easement shall be a burden upon and shall run with the Project Area in perpetuity and shall bind the Grantor, its successors and assigns forever.

(24) The rights herein granted shall be in addition to, and not in limitation of, any other rights and remedies available to the Grantee for protection of the Project Area.

(25) This easement does not grant access to the property by the general public.

(26) In the event that the project is not implemented, this Easement shall become null and void.

TO HAVE AND TO HOLD this Conservation Easement together with all the appurtenances and privileges belonging or in any way pertaining thereto, either in law or in equity, for the proper use and benefit of the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, Ishmel Howard, Grantor, has executed this Deed of Conservation Easement this 10 day of JAN., 2008.

Ishmel Howard
Authorized Representative of Grantor

STATE OF KENTUCKY

COUNTY OF Greenup

I, the undersigned, a notary public duly authorized in the county and state aforesaid, do hereby certify that on this day Ishmel Howard personally appeared before me and executed the foregoing instrument as _____ of So. Shore, Ky, and acknowledged before me that he executed the same s such officer in the name of and for and on behalf of the said entity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal, this 10 day of Jan., 2008.

NOTARY PUBLIC

My Commission Expires: _____

James R. Osman
Kentucky, State At Large
My Commission Expires March 12, 2010

IN WITNESS WHEREOF, the Ky. Dept of Fish & Wildlife Grantee, accepts this deed of conservation easement this 23rd day of January, 2008.

Dr. Jonathan Gassett, Commissioner
Authorized Representative of Grantee

STATE OF KENTUCKY

COUNTY OF Frankfort

I, the undersigned, a notary public duly authorized in the county and state aforesaid, do hereby certify that on this day Jonathan Gassett personally appeared before me and executed the foregoing instrument as Grantee of Ky. Dept. of Fish & Wildlife, and acknowledged before me that he executed the same as such officer in the name of and for and on behalf of the said entity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal, this 23rd day of January, 2008.

Nancy J. McClure

NOTARY PUBLIC

My Commission Expires: 6/6/09

THIS INSTRUMENT PREPARED BY:

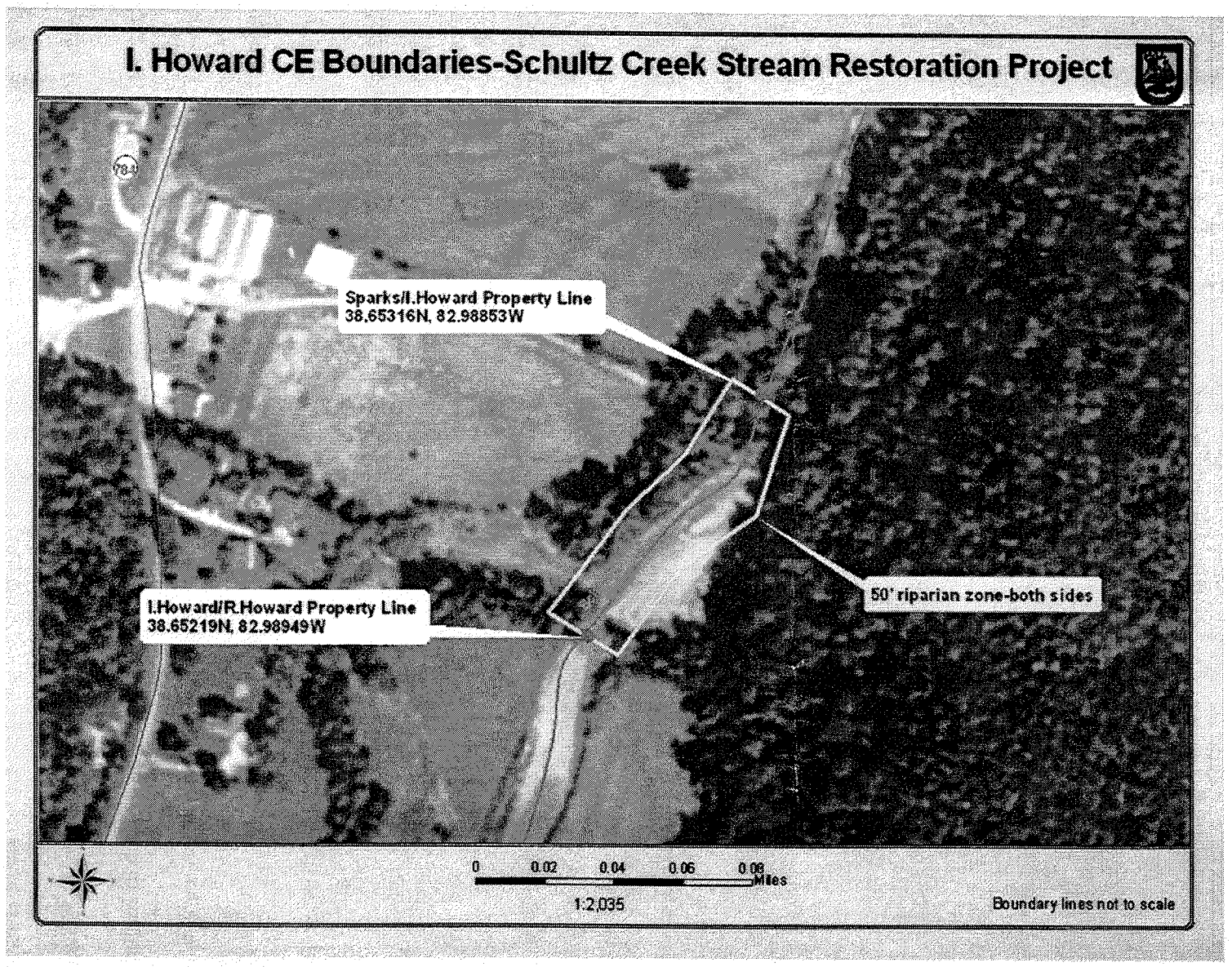
Fisheries Division
#1 Sportsman's Lane
Frankfort, KY 40601

EXIBIT "A"

Project Area Description

The "Project Area" referenced in the conservation easement is described as follows: The project area includes sections of Schultz Creek and shall extend from the northern Sparks/I.Howard property line (lat 38.65316, long 82.98853W) upstream to the southern I.Howard/R.Howard property line (lat 38.65219N, long 82.98949W). The width of the project area shall include the stream bed and the adjacent land along both sides of the stream, beginning at the water's edge, at normal flow, extending fifty (50) feet from the edge of water.

The adjacent areas of Schultz Creek within the project area are to be planted with trees. Refer to the attached diagram.


I. Howard CE Boundaries-Schultz Creek Stream Restoration Project
784
Sparks/I.Howard Property Line
38.65316N, 82.98853W
I.Howard/R.Howard Property Line
38.65219N, 82.98949W
50' riparian zone-both sides
0
0.02
0.04
0.06
0.08
Miles
1:2,035
Boundary lines not to scale

DEED OF CONSERVATION EASEMENT

THIS DEED OF CONSERVATION EASEMENT is entered into by and between Robert Howard (hereinafter "Grantor") and the Department of Fish and Wildlife Resources, for and on behalf of the Commonwealth of Kentucky (hereinafter "Grantee").

WITNESS THAT:

WHEREAS, the Grantor is the landowner of certain real property (hereinafter "Project Area") located in Greenup County, Kentucky, and more particularly described in the "Project Area Description" attached hereto and incorporated herein as Exhibit A; and

WHEREAS, the Project Area will be improved by creating better access to a floodplain, bank stabilization, establishment of riparian zone, and creating better aquatic habitat; and

WHEREAS, the remainder of the Project Area remains in a substantially undisturbed, natural state and has significant value as stream habitat; and

WHEREAS, the Grantee is a governmental body empowered to hold an interest in real property under the laws of the Commonwealth of Kentucky and the United States and, therefore, qualifies as a holder pursuant to KRS 382.800; and

WHEREAS, both Grantor and Grantee desire to retain and protect the natural, scenic, and open-space values of the Project Area, and assure the Project Area's availability for agricultural, forest, recreational, and open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, or cultural aspects of the Project Area; and

WHEREAS, KRS 382.800 through KRS 382.860 permits the creation of conservation easements for the purposes of, inter alia, retaining land or water areas predominantly in their natural, scenic, open or wooded condition or as suitable habitat for fish, plants, or wildlife and to insure that the areas will be available for agricultural, forest, recreational, educational, or open-space use; and

NOW, THEREFORE, in consideration of the mutual covenants contained herein; and further, pursuant to KRS 382.800 through 382.860, Grantor does hereby convey to Grantee a Conservation Easement (hereinafter "Easement") in perpetuity over the Project Area to be held for the benefit of the people of the Commonwealth of Kentucky and consisting of the following:

(1) The Project Area shall be maintained in perpetuity for the following purpose:

stream habitat

(2) Grantee shall manage the Project Area in strict accordance with:

(a) KRS Chapter 150

(b) KRS 382.800 through 382.860, and

(c) The detailed channel design plan pertaining to the Project Area which has been generated by the Grantee.

(3) The Grantee has the right of visual access to and view of the Project Area in its natural, scenic, open and undisturbed condition.

(4) The Grantee has the right to enter the Project Area, in a reasonable manner and at reasonable times, for the purposes of inspecting the same to determine compliance with this Easement.

(5) There shall be no removal, destruction, cutting, trimming, mowing, alteration, or spraying with biocides of any vegetation, nor any disturbance or change in the natural habitat within the Project Area in any manner unless addressed in the final design plan or specifically authorized by the Grantee.

(6) There shall be no planting or introduction of any species of vegetation within the Project Area unless addressed in the final design plan or specifically authorized by the Grantee.

(7) There shall be no harvesting of timber within the Project Area unless addressed in the final design plan or specifically authorized by the Grantee.

(8) There shall be no commercial or industrial activity undertaken or allowed within the Project Area, nor shall any right of passage across or upon the Project Area be allowed or granted if that right of passage is used in conjunction with commercial or industrial activity. (KRS 382.800(1) clearly references agricultural usage.)

(9) Grantor shall be allowed to remove trash and debris from the Project Area.

(10) Except as deemed necessary by the Grantee in completing the channel design plan, there shall be no filling, excavation, or dredging within the Project Area.

(11) There shall be no mining or drilling within the Project Area.

(12) There shall be no removal of topsoil, sand, gravel, rock, minerals or other materials within the Project Area.

(13) There shall be no dumping of ashes, trash, garbage, or any other material within the Project Area.

(14) There shall be no changing of the topography within the Project Area in any manner.

(15) There shall be no construction or placing of temporary or permanent buildings, mobile homes, advertising signs, billboards, or other advertising material, or other structures within the Project Area.

(16) Except with the written consent of the Grantee, there shall be no building of new roads, trails, or other rights of way within the Project Area. Existing trails and roads may be maintained by reasonable means consistent with the purposes of this Easement.

(17) There shall be no introduction of non-native wildlife as defined by 301 KAR 2:081 and 301 KAR 1:122 into the Project Area without the written consent of the Grantee. (Plants are covered in paragraph 6.)

(18) Except as deemed necessary by the Grantee in completing the channel design plan, there shall be no damming, dredging or construction in any free-flowing water body, nor construction of any weirs, groins, or dikes in any wetlands, or any manipulation or alteration of natural water courses, fresh water lake or pond shores, marshes, wetlands, or other water bodies nor any activities or uses detrimental to water purity within the Project Area.

(19) Except as deemed necessary by the Grantee in completing the channel design plan , there shall be no operation of mechanical or motorized vehicles within the stream channel, not including designated crossings. Mechanical or motorized vehicles shall cross perpendicular to the channel, as opposed to, driving the vehicle up and down the length of the stream.

(20) Where applicable, there shall be no destruction of fencing placed within the Project Area. After the five-year monitoring period the Grantor agrees to maintain the fence in a condition that is at a minimum that with which it was received from the Grantee.

(21) Any use of the Project Area or any activity thereon which, in the opinion of the Grantee, is or may become inconsistent with the purpose of this Easement, which is the preservation of the area in its natural and undisturbed condition for the purposes set out in KRS 382.800(1) and the management and protection of its environmental systems, is prohibited.

(22) In the event of a violation of any term, condition, or restriction contained in this Easement, the Grantee may immediately enforce any of the remedies including but not limited to those set forth in KRS 382.990. Any failure by the Grantee to avail itself of these remedies shall not be deemed to be a waiver or forfeiture of the right to enforce any term, condition, covenant of purpose of this Easement.

(23) This Easement shall be a burden upon and shall run with the Project Area in perpetuity and shall bind the Grantor, its successors and assigns forever.

(24) The rights herein granted shall be in addition to, and not in limitation of, any other rights and remedies available to the Grantee for protection of the Project Area.

(25) This easement does not grant access to the property by the general public.

(26) In the event that the project is not implemented, this Easement shall become null and void.

TO HAVE AND TO HOLD this Conservation Easement together with all the appurtenances and privileges belonging or in any way pertaining thereto, either in law or in equity, for the proper use and benefit of the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, Robert Howard, Grantor, has executed this Deed of Conservation Easement this 18th day of February, 2008

Robert Dale Howard
Authorized Representative of Grantor

STATE OF KENTUCKY

COUNTY OF Greenup

I, the undersigned, a notary public duly authorized in the county and state aforesaid, do hereby certify that on this day Robert Howard personally appeared before me and executed the foregoing instrument as Deed of Conservation Easement and acknowledged before me that he executed the same s such officer in the name of and for and on behalf of the said entity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal, this 28 day of February, 2008.

NOTARY PUBLIC

My Commission Expires: 7/21/08

IN WITNESS WHEREOF, the KDFWR, Grantee, accepts this deed of conservation easement this 28th day of February, 2008.

Dr. Jonathan Gassett, Commissioner
Authorized Representative of Grantee

STATE OF KENTUCKY

COUNTY OF Franklin

I, the undersigned, a notary public duly authorized in the county and state aforesaid, do hereby certify that on this day Dr. Jonathan Gassett personally appeared before me and executed the foregoing instrument as Grantee of KDFWR, and acknowledged before me that he executed the same as such officer in the name of and for and on behalf of the said entity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal, this 28th day of February, 2008.

Nancy J. McClure

NOTARY PUBLIC

My Commission Expires: 6/6/09

THIS INSTRUMENT PREPARED BY:

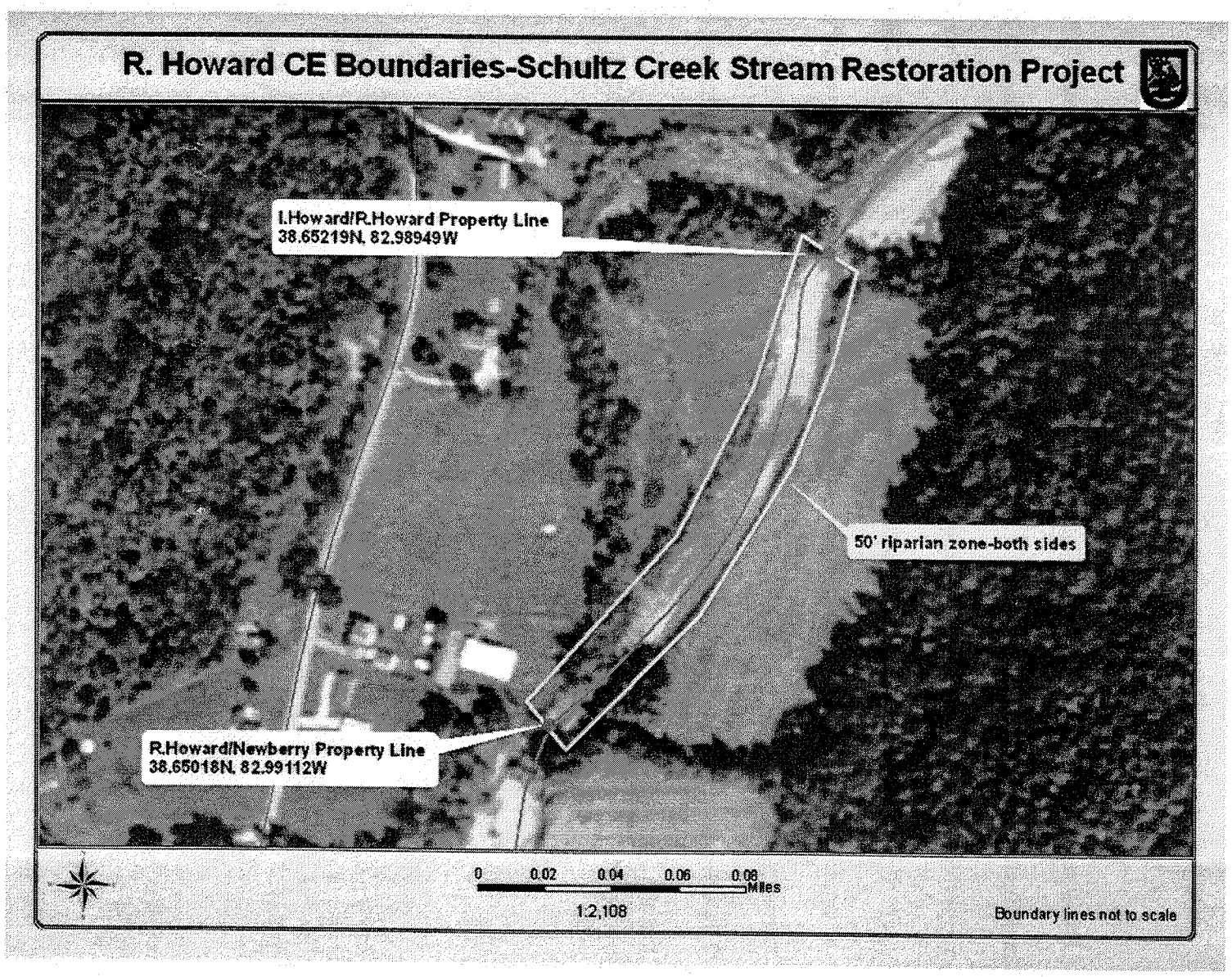
Fisheries Division
#1 Sportsman's Lane
Frankfort, KY 40601

EXIBIT "A"

Project Area Description

The "Project Area" referenced in the conservation easement is described as follows: The project area includes sections of Schultz Creek and shall extend from the northern I.Howard/R.Howard property line (lat 38.65219N, long 82.98949W) upstream to the southern R.Howard/Newberry property line (lat 38.65018, long 82.99112W). The width of the project area shall include the stream bed and the adjacent land along both sides of the stream, beginning at the water's edge, at normal flow, extending fifty (50) feet from the edge of water.

The adjacent areas of Schultz Creek within the project area are to be planted with trees. Refer to the attached diagram.


R. Howard CE Boundaries-Schultz Creek Stream Restoration Project
I.Howard/R.Howard Property Line
38.65219N, 82.98949W
50' riparian zone-both sides
R.Howard/Newberry Property Line
38.65018N, 82.99112W
0 0.02 0.04 0.06 0.08
Miles
1:2,108
Boundary lines not to scale

DEED OF CONSERVATION EASEMENT

THIS DEED OF CONSERVATION EASEMENT is entered into by and between Jeff Sparks (hereinafter "Grantor") and the Department of Fish and Wildlife Resources, for and on behalf of the Commonwealth of Kentucky (hereinafter "Grantee").

WITNESS THAT:

WHEREAS, the Grantor is the landowner of certain real property (hereinafter "Project Area") located in Greenup County, Kentucky, and more particularly described in the "Project Area Description" attached hereto and incorporated herein as Exhibit A; and

WHEREAS, the Project Area will be improved by creating better access to a floodplain, bank stabilization, establishment of riparian zone, and creating better aquatic habitat; and

WHEREAS, the remainder of the Project Area remains in a substantially undisturbed, natural state and has significant value as stream habitat; and

WHEREAS, the Grantee is a governmental body empowered to hold an interest in real property under the laws of the Commonwealth of Kentucky and the United States and, therefore, qualifies as a holder pursuant to KRS 382.800; and

WHEREAS, both Grantor and Grantee desire to retain and protect the natural, scenic, and open-space values of the Project Area, and assure the Project Area's availability for agricultural, forest, recreational, and open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, or cultural aspects of the Project Area; and

WHEREAS, KRS 382.800 through KRS 382.860 permits the creation of conservation easements for the purposes of, inter alia, retaining land or water areas predominantly in their natural, scenic, open or wooded condition or as suitable habitat for fish, plants, or wildlife and to insure that the areas will be available for agricultural, forest, recreational, educational, or open-space use; and

NOW, THEREFORE, in consideration of the mutual covenants contained herein; and further, pursuant to KRS 382.800 through 382.860, Grantor does hereby convey to Grantee a Conservation Easement (hereinafter "Easement") in perpetuity over the Project Area to be held for the benefit of the people of the Commonwealth of Kentucky and consisting of the following:

(1) The Project Area shall be maintained in perpetuity for the following purpose:

stream habitat

(2) Grantee shall manage the Project Area in strict accordance with:

(a) KRS Chapter 150

(b) KRS 382.800 through 382.860, and

(c) The detailed channel design plan pertaining to the Project Area which has been generated by the Grantee.

(3) The Grantee has the right of visual access to and view of the Project Area in its natural, scenic, open and undisturbed condition.

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(15) There shall be no construction or placing of temporary or permanent buildings, mobile homes, advertising signs, billboards, or other advertising material, or other structures within the Project Area.

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(19) Except as deemed necessary by the Grantee in completing the channel design plan , there shall be no operation of mechanical or motorized vehicles within the stream channel, not including designated crossings. Mechanical or motorized vehicles shall cross perpendicular to the channel, as opposed to, driving the vehicle up and down the length of the stream.

(20) Where applicable, there shall be no destruction of fencing placed within the Project Area. After the five-year monitoring period the Grantor agrees to maintain the fence in a condition that is at a minimum that with which it was received from the Grantee.

(21) Any use of the Project Area or any activity thereon which, in the opinion of the Grantee, is or may become inconsistent with the purpose of this Easement, which is the preservation of the area in its natural and undisturbed condition for the purposes set out in KRS 382.800(1) and the management and protection of its environmental systems, is prohibited.

(22) In the event of a violation of any term, condition, or restriction contained in this Easement, the Grantee may immediately enforce any of the remedies including but not limited to those set forth in KRS 382.990. Any failure by the Grantee to avail itself of these remedies shall not be deemed to be a waiver or forfeiture of the right to enforce any term, condition, covenant of purpose of this Easement.

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(25) This easement does not grant access to the property by the general public.

(26) In the event that the project is not implemented, this Easement shall become null and void.

TO HAVE AND TO HOLD this Conservation Easement together with all the appurtenances and privileges belonging or in any way pertaining thereto, either in law or in equity, for the proper use and benefit of the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, Jeff Sparks, Grantor, has executed this Deed of Conservation Easement this 27 day of Dec, 2007.

Jeff Sparks

Authorized Representative of Grantor

STATE OF KENTUCKY

COUNTY OF Greenup

I, the undersigned, a notary public duly authorized in the county and state aforesaid, do hereby certify that on this day Jeff Sparks personally appeared before me and executed the foregoing instrument as Grantor of Said Property, and acknowledged before me that he executed the same s such officer in the name of and for and on behalf of the said entity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal, this 27 day of Dec, 2007.

NOTARY PUBLIC

My Commission Expires: James R. Osman
Kentucky, State At Large
My Commission Expires March 12, 2010

IN WITNESS WHEREOF, the KDFWR, Grantee, accepts this deed of conservation easement this 10th day of January, 2008.

Dr. Jonathan Gassett, Commissioner
Authorized Representative of Grantee

STATE OF KENTUCKY

COUNTY OF Franklin

I, the undersigned, a notary public duly authorized in the county and state aforesaid, do hereby certify that on this day Dr Jonathan Gassett personally appeared before me and executed the foregoing instrument as Grantee of KDFWR, and acknowledged before me that he executed the same as such officer in the name of and for and on behalf of the said entity.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal, this 10th day of January, 2008.

Nancy J. Mackey

NOTARY PUBLIC

My Commission Expires: 6/6/09

THIS INSTRUMENT PREPARED BY:

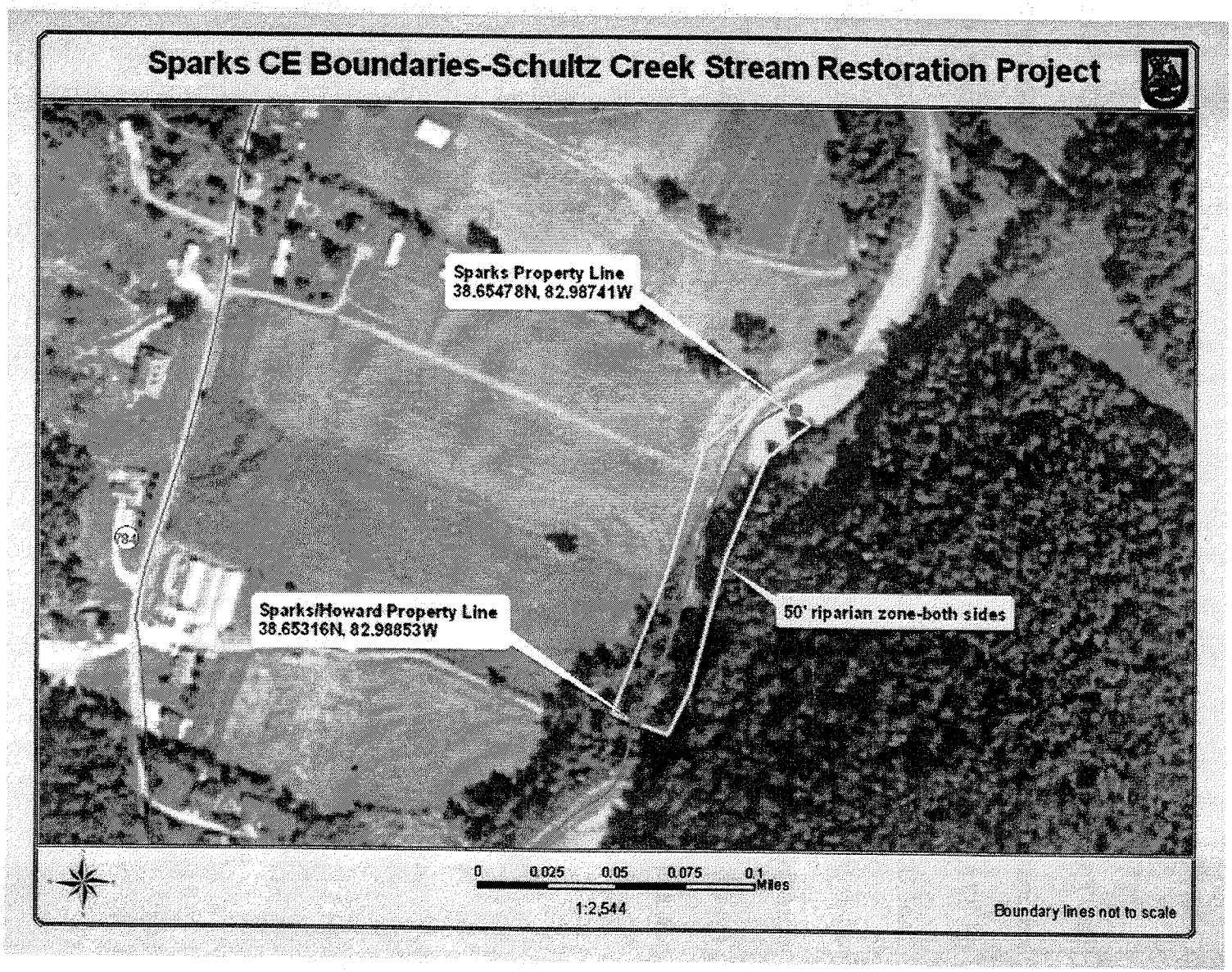
Fisheries Division
#1 Sportsman's Lane
Frankfort, KY 40601

EXIBIT "A"

Project Area Description

The "Project Area" referenced in the conservation easement is described as follows: The project area includes sections of Schultz Creek and shall extend from the northern Sparks property line (lat 38.65478N, long 82.98741W) upstream to the southern Sparks/I.Howard property line (lat 38.65316, long 82.98853W). The width of the project area shall include the stream bed and the adjacent land along both sides of the stream, beginning at the water's edge, at normal flow, extending fifty (50) feet from the edge of water.

The adjacent areas of Schultz Creek within the project area are to be planted with trees. Refer to the attached diagram.

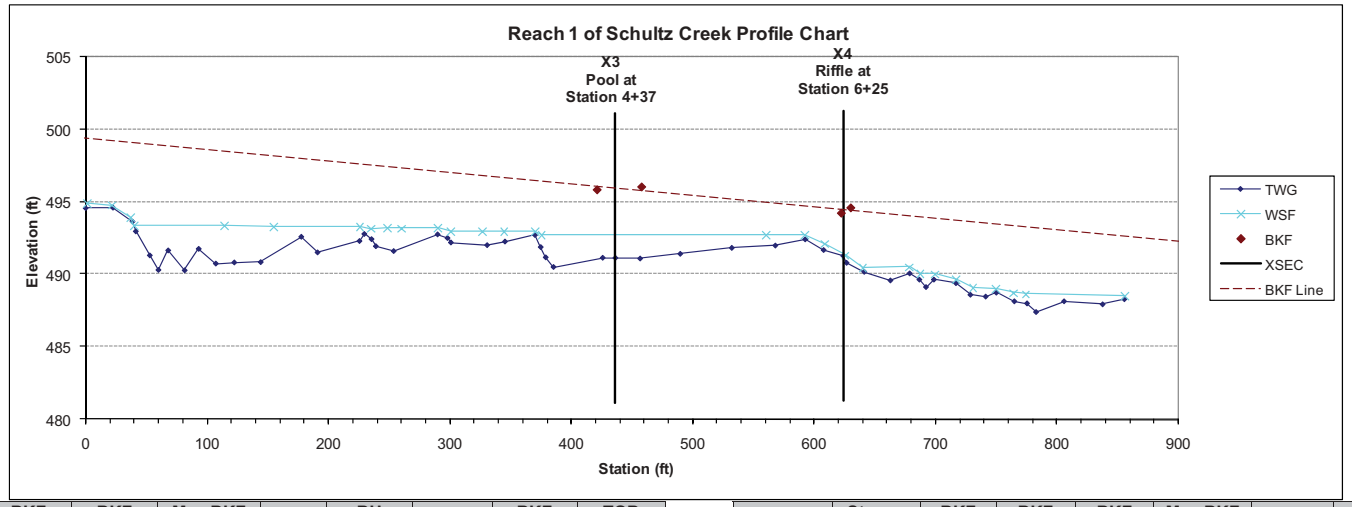

Sparks CE Boundaries-Schultz Creek Stream Restoration Project
Sparks Property Line
38.65478N, 82.98741W
Sparks/Howard Property Line
38.65316N, 82.98853W
50' riparian zone-both sides
0 0.025 0.05 0.075 0.1
Miles
1:2,544
Boundary lines not to scale

APPENDIX F

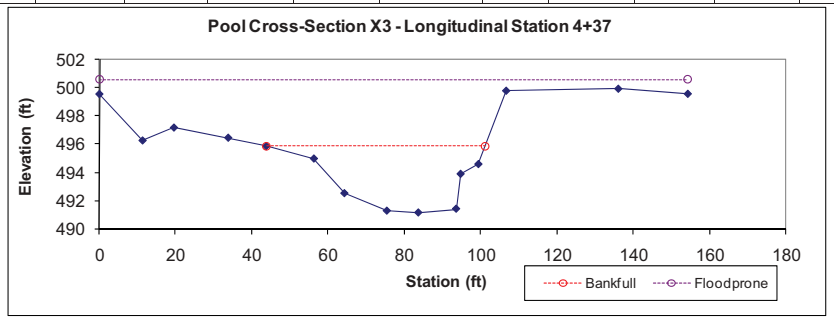
GEOMORPHOLOGY DATA

On-Site Existing Conditions Data Schultz Creek Reach 1

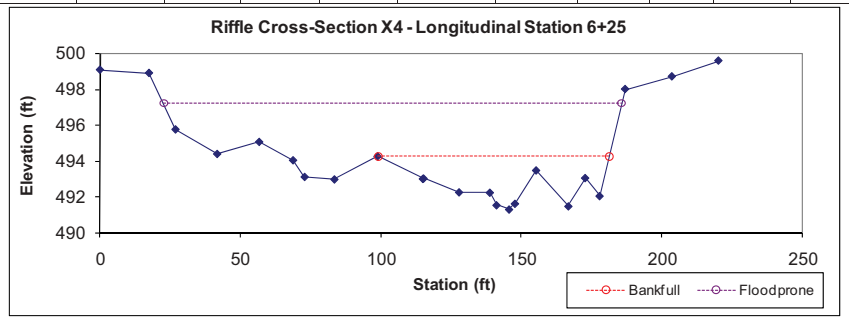
Parameter		Minimum	Maximum	Average
Rosgen Stream Type		----	----	B4c
Drainage Area (sq mi)		----	----	9.5
Reach Length Surveyed (ft)		----	----	856.4
Dimension	Bankfull Width (ft)	57.4	82.3	82.3
	Bankfull Mean Depth (ft)	1.6	2.8	1.6
	Width/Depth Ratio	20.2	50.3	50.3
	Bankfull Area (sq ft)	134.7	163.0	134.7
	Bankfull Max Depth (ft)	3.0	4.7	3.0
	Width of Floodprone Area (ft)	154.3	163.1	163.1
	Entrenchement Ratio	2.0	2.7	2.0
	Max Pool Depth (ft)	4.7	4.7	4.7
	Ratio of Max Pool Depth to Bankfull Depth	2.9	2.9	2.9
	Pool Width (ft)	57.4	57.4	57.4
	Ratio of Pool Width to Bankfull Width	0.7	0.7	0.7
	Pool to Pool Spacing (ft)	29.3	277.8	98.7
	Ratio of Pool to Pool Spacing to Bankfull Width	0.4	3.4	1.2
	Bank Height Ratio	2.3	2.3	2.3
Pattern	Meander Length (ft)*	499.7	669.2	584.5
	Meander Length Ratio	6.1	8.1	7.1
	Radius of Curvature (ft)	144.3	181.7	163.0
	Radius of Curvature Ratio	1.8	2.2	2.0
	Meander Belt Width (ft)*	----	----	202.2
	Meander Width Ratio	----	----	2.5
	Sinuosity	----	----	1.3
Profile	Valley Slope (ft/ft)	----	----	0.0060
	WS Slope (ft/ft)	----	----	0.0075
	Channel Slope (ft/ft)	----	----	0.0074
	Pool Slope (ft/ft)	0.0007	0.0045	0.0022
	Ratio of Pool Slope to WS Slope	0.1	0.6	0.3



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		163.0	57.4	2.8	4.7	20.2	1.8	2.7	495.9	499.6



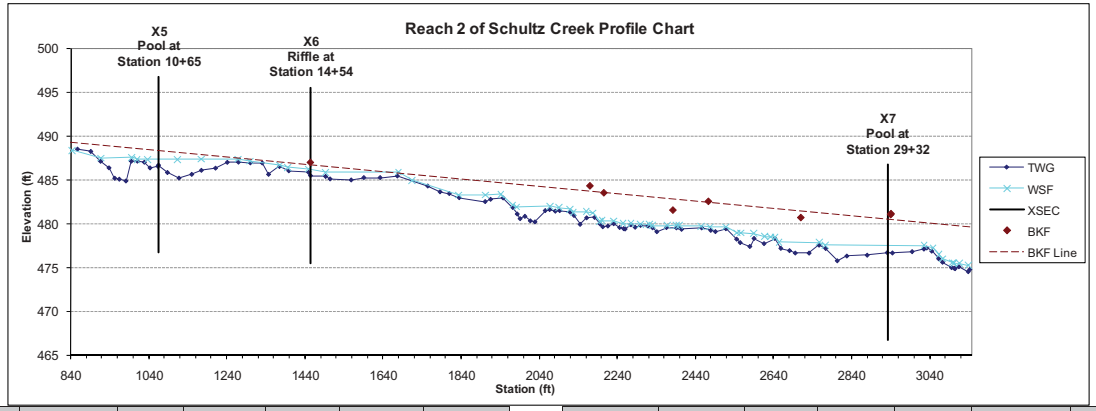
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B4c	134.7	82.3	1.6	3.0	50.3	2.3	2.0	494.3	498.0



Reach 1
of Shultz Creek
Profile and Cross-section Data

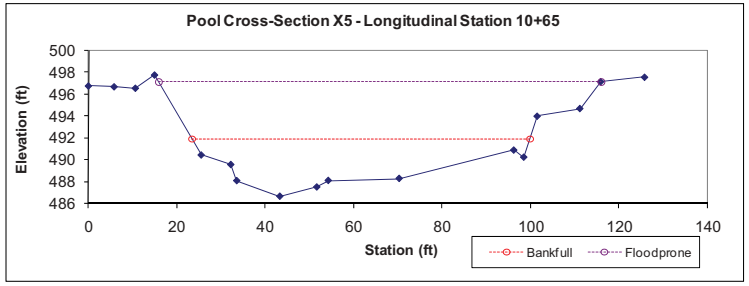
On-Site Existing Conditions Data Schultz Creek Reach 2

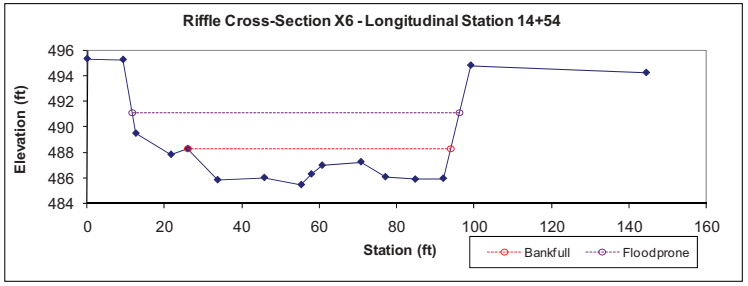
Parameter		Minimum	Maximum	Average
Rosgen Stream Type		----	----	F4
Drainage Area (sq mi)		----	----	13.4
Reach Length Surveyed (ft)		----	----	2286.9
Dimension	Bankfull Width (ft)	67.8	76.4	67.8
	Bankfull Mean Depth (ft)	2.0	3.1	2.0
	Width/Depth Ratio	24.7	34.8	34.8
	Bankfull Area (sq ft)	132.1	236.6	132.1
	Bankfull Max Depth (ft)	2.8	5.2	2.8
	Width of Floodprone Area (ft)	84.4	100.0	84.4
	Entrenchement Ratio	1.2	1.3	1.2
	Max Pool Depth (ft)	4.5	5.2	4.9
	Ratio of Max Pool Depth to Bankfull Depth	2.3	2.7	2.5
	Pool Width (ft)	76.4	86.4	81.4
	Ratio of Pool Width to Bankfull Width	1.1	1.3	1.2
	Pool to Pool Spacing (ft)	49.1	874.3	178.2
	Ratio of Pool to Pool Spacing to Bankfull Width	0.7	12.9	2.6
	Bank Height Ratio	3.3	3.3	3.3
Pattern	Meander Length (ft)	494.3	913.1	769.6
	Meander Length Ratio	7.3	13.5	11.3
	Radius of Curvature (ft)	30.3	569.9	240.1
	Radius of Curvature Ratio	0.4	8.4	3.5
	Meander Belt Width (ft)	----	----	73.6
	Meander Width Ratio	----	----	1.1
	Sinuosity	----	----	1.1
Profile	Valley Slope (ft/ft)	----	----	0.0053
	WS Slope (ft/ft)	----	----	0.0057
	Channel Slope (ft/ft)	----	----	0.0060
	Pool Slope (ft/ft)	0.0000	0.0013	0.0006
	Ratio of Pool Slope to WS Slope	0.0	0.2	0.1



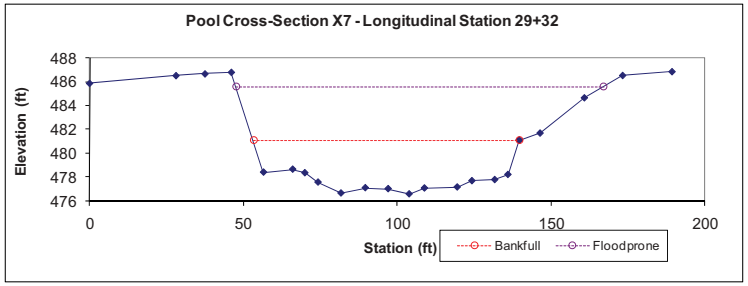
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		236.6	76.4	3.1	5.2	24.7	2.0	1.3	491.9	497.1

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F4	132.1	67.8	2.0	2.8	34.8	3.3	1.2	488.3	494.8





Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		298.1	86.4	3.5	4.5	25.1	1.0	1.4	481.1	481.1



Reach 2
of Schultz Creek
Cross-section Data

APPENDIX G

PHOTOGRAPHS

TABLE OF CONTENTS

PHOTOGRAPHS OF SCHULTZ CREEK
REACH 1

PHOTO 1: STATION 7+25

PHOTO 2: ~ STATION 8+00

PHOTO 3: ~ STATION 8+50

PHOTO 4: : ~ STATION 8+50

PHOTO 5: ~ STATION 12+75

PHOTO 6: ~STATION 13+50

PHOTOGRAPHS OF SCHULTZ CREEK
REACH 2

PHOTO 7: ~STATION 16+00

PHOTO 8: ~STATION 16+75

PHOTO 9: ~ STATION 16+75

PHOTO 10: ~STATION 17+00

PHOTO 11: ~ STATION 19+00

PHOTO 12: ~STATION 19+50

PHOTO 13: ~STATION 21+00

PHOTO 14: ~STATION 22+50

PHOTO 15: ~ STATION 23+50

PHOTO 16: ~ STATION 27+00

PHOTO 17: ~ STATION 29+00

PHOTO 18: ~ STATION 30+00

PHOTO 19: ~ STATION 33+00

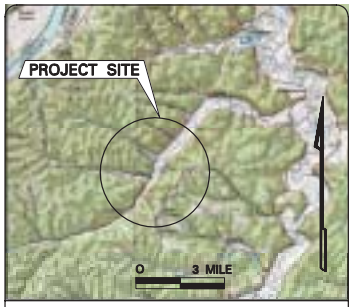
PHOTO 20: ~ STATION 36+00

PHOTO 21: STATION 39+15

PHOTO 22: STATION 39+15

APPENDIX H

STREAM RESTORATION DESIGN



VICINITY MAP

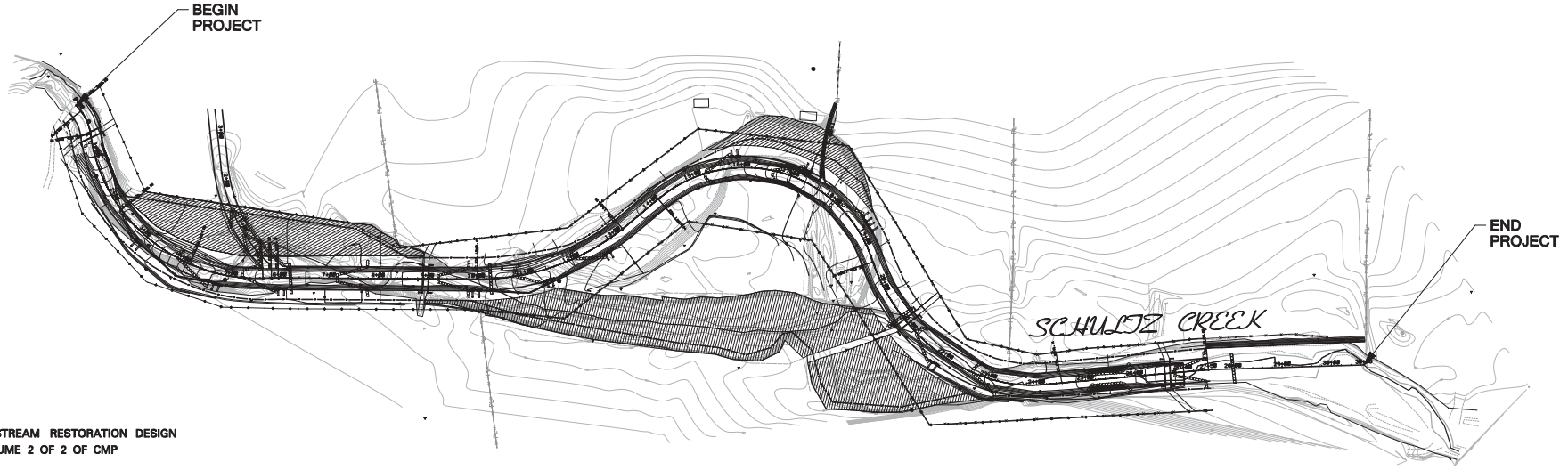
STREAM RESTORATION
SCHULTZ CREEK
GREENUP COUNTY

KENTUCKY DEPARTMENT OF FISH & WILDLIFE RESOURCES
#1 SPORTSMAN'S LANE
FRANKFORT, KY 40601
Account # 660–C3WA–SC01–00

COMMONWEALTH OF KENTUCKY
GOVERNOR STEVE BESHEAR
FINANCE AND ADMINISTRATION CABINET
DEPARTMENT FOR FACILITIES MANAGEMENT
DIVISION OF ENGINEERING AND CONTRACT ADMINISTRATION

DESIGN DATA

	SCHULTZ CREEK		
	REACH 1	REACH 2	DRY FORK
DESIGN STREAM TYPE	C4	C4	C4
DESIGN REACH LENGTH (LF)	583	2167	152
BANKFULL XSEC AREA (SF)	140	185	70.0
BANKFULL WIDTH (FT)	41.0	47.1	29.0
BANKFULL MEAN DEPTH (FT)	3.4	3.9	1.9
BANKFULL MAX DEPTH (FT)	4.8	5.5	2.4
W/D RATIO	12	12	12



APPENDIX H: STREAM RESTORATION DESIGN
VOLUME 2 OF 2 OF CMP

INDEX OF DRAWINGS

NO.	DATE	BY	REVISION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION
07/10/09

KENTUCKY DEPARTMENT OF FISH AND WILDLIFE RESOURCES
GREENUP COUNTY, KENTUCKY

Baker
Michael Baker Jr., Inc.
5088 West Washington Street
Charleston, West Virginia 25313
Phone 304-769-0821
Fax 304-769-0822

LETTING DATE:

P. Fogarty
PROJECT ENGINEER

C. Mower / W. Harman
PROJECT DESIGNER

PROJECT ENGINEER
SIGNATURE: P.E.

SHEET 0 OF 4

STREAM CONVENTIONAL SYMBOLS

- ROOT WAD
- ROCK J-HOOK
- ROCK CROSS VANE
- DOUBLE WING DEFLECTOR
- PERMANENT STREAM CROSSING
- TEMPORARY SILT CHECK
- TRANSPLANTS
- SILT FENCE
- CONSERVATION EASEMENT
- CENTERLINE
- BANKFULL CHANNEL
- FLOOD PLAIN LIMITS
- TEMPORARY STOCKPILE OR STAGING AREA
- FENCE LINE
- PROPERTY LINE
- TRANSPLANTED VEGETATION
- TREE REMOVAL
- TREE PROTECTION
- FILL EXISTING CHANNEL

NOTE: NOT ALL SYMBOLS MAY BE USED.

GENERAL NOTES

Grading activities will be performed in the dry as much as possible. For instances in which the Contractor must work within the stream, all equipment shall be removed from the channel at the end of each working day. The Contractor shall enter and exit the stream channel at locations where disturbance will be minimized. Silt checks shall be used in appropriated locations. Erosion control matting and temporary/permanent seeding shall be placed onall disturbed banks, including temporary stockpile areas.

Excavated material will be temporarily stockpiled in designated areas. Silt fence shall be used to prevent sediment migration from the stockpiles toward the open channels on site. Any stockpiled soil which is not used within 15 working days or 30 calendar days, whichever is sooner, shall be covered with mulch and temporary seeding. Temporary stockpile areas, staging areas, and construction access' shall be regraded and seeded properly upon construction completion. Clearing limits are to be contained within valley and all valley slopes are to be protected.

ROCK SIZES

CLASS	ACCEPTANCE CRITERIA FOR RIP RAP AND STONE		
	MINIMUM	AVERAGE	MAXIMUM
WASHED 57 STONE	0.25"	0.5"	1.5"
A	2"	4"	6"
B	5"	8"	12"
I	5"	10"	17"
II	9"	14"	23"
*BOULDER 48"x36"x24"	24"	36"	48"

VEGETATION SELECTION

BARE-ROOT AND LIVE STAKE SPECIES

Common Name	Scientific Name	Percent Planted by Species	Planting Density
Streambanks (Live Stakes)			
Silky dogwood	*Cornus obliqua*	40%	65 to 100 stems per 1,000 SF
Silky willow	*Salix sericea*	40%	65 to 100 stems per 1,000 SF
Elderberry	*Sambucus canadensis*	20%	33 to 50 stems per 1,000 SF
Stream Riparian Buffer (Bare-root Trees)			
River birch	*Betula nigra*	30%	140 stems per acre
Tulip poplar	*Liriodendron tulipifera*	30%	140 stems per acre
Sycamore	*Platanus occidentalis*	20%	85 stems per acre
Southern red oak	*Quercus rubra*	20%	85 stems per acre
Alternate Species			
Silky Cornel	*Cornus amomum*		
Black Willow	*Salix nigra*		
Ninebark	*Physocarpus opulifolius*		

PERMANENT SEED MIXTURE

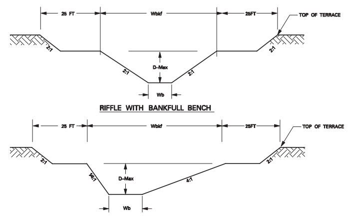
Common Name	Scientific Name	Percent of Mixture	Seeding Density (lbs/acre)	Wetness Tolerance
Floodplain and Buffer Areas				
Virginia wildrye	*Elymus virginicus*	25%	2	FAC
Switchgrass	*Panicum virgatum*	25%	3	FAC+
Fox sedge	*Carex vulpinoidea*	25%	3	OBL
Redtop	*Agrostis alba*	25%	2	FAC
Restored Streambanks				
Virginia wildrye	*Elymus virginicus*	30%	12	FAC
Switchgrass	*Panicum virgatum*	30%	3	FAC+
Soft rush	*Juncus effusus*	20%	2	FACW+
Deertongue	*Dichathelium Clandestinum*	20%	12	FACW
Alternate Species				
Rice Cutgrass	*Leesia oryzoides*			
Wood Reed-Grass	*Cinna arundinacea*			

TEMPORARY SEEDING

The following table lists thetemporary seed mix for the project site. All disturbed areas will be stabilized using mulch and temporary seed.

Common Name	Rate	Dates
WINTER WHEAT	130 LBS/ACRE	NOVEMBER TO APRIL
WINTER OR PERENNIAL RYE	130 LBS/ACRE	NOVEMBER TO APRIL
BROWN TOP MILLET	40 LBS/ACRE	APRIL TO AUGUST

TYPICAL RIFFLE, POOL, AND BANKFULL BENCH CROSS SECTIONS



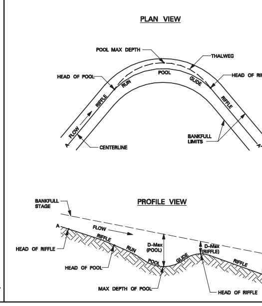
RIFFLE WITH BANKFULL BENCH

POOL WITH BANKFULL BENCH

SCHULTZ CREEK						
REACH 1		REACH 2		DRY FORK		
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	
41.0 ft	69.7ft	47.1 ft	80.1 ft	29.0 ft	37.0 ft	WIDTH OF BANKFULL (Wbkf)
3.4 ft	6.8 ft	3.9 ft	7.9 ft	1.9 ft	2.4 ft	MINIMUM DEPTH (D)
4.8 ft	12.0 ft	5.5 ft	13.7 ft	2.4 ft	3.1 ft	MAXIMUM DEPTH (D-Max)
12	5.8	12	5.8	12	19.5	WIDTH TO DEPTH RATIO (Wbkf/D)
140 sq ft	280 ft/ft	185 sq ft	370 ft/ft	70 sq ft	70.1 ft/ft	BANKFULL AREA (Abkf)
21.8 ft	21.8	25.1 ft	25.1	21.4 ft	16.7	BOTTOM WIDTH (Wb)

NOTES:
1. DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
2. POOLS SHOWN ABOVE ARE LEFT POOLS ONLY.

TYPICAL PLAN VIEW AND PROFILE

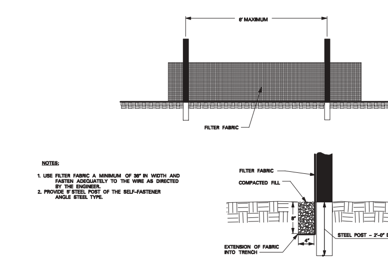


PLAN VIEW

PROFILE VIEW

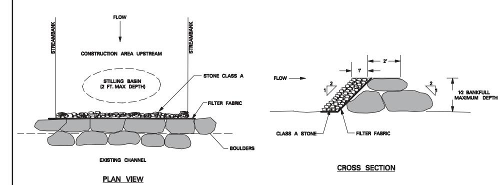
NOTES:
1. THE POINTS SHOWN, e.g. HEAD OF RIFFLE, HEAD OF POOL AND MAX DEPTH OF POOL ARE THE CONTROL POINTS USED TO CUT THE PROFILE; HOWEVER, THE CONTRACTOR SHOULD CREATE SMOOTH TRANSITIONS BETWEEN CONTROL POINTS AS SHOWN ABOVE.
2. USE THE FACET SLOPES IN THE TABLE AS A GUIDE TO ENSURE THAT THE FEATURES ARE APPROPRIATELY GRADED.
3. THE HEAD OF RIFFLE ELEVATION SHOULD NOT EXCEED THE HEAD OF POOL ELEVATION.
4. THE CHANGE IN WIDTH BETWEEN THE RIFFLES AND POOLS SHOULD OCCUR GRADUALLY OVER THE ENTIRE LENGTH OF THE BEND.

TEMPORARY SILT FENCE



NOTES:
1. USE FILTER FABRIC A MINIMUM OF 36" IN WIDTH AND FASTEN ADEQUATELY TO THE WIRE AS DIRECTED BY THE ENGINEER.
2. PROVIDE 5' STEEL POST OF THE SELF-FASTENER ANGLE STEEL TYPE.

SILT CHECK



PLAN VIEW

CROSS SECTION

QUANTITIES

Description	Quantity	Unit
Mobilization & Demobilization	TBD	LS
Construction Survey and Quality Control	TBD	LS
Access Road Construction	TBD	LS
Clearing and Grubbing	TBD	LS
Excavation-Total	TBD	LS
Debris Removal	TBD	LS
Silt Fence/Temporary Sediment Controls (i.e. Hay bales)	TBD	LS
Creation of Bankfull Benches	TBD	LS
Log Cross Vanes	TBD	EACH
Rock Cross Vanes	TBD	EACH
Double Drop Rock Cross Vanes	TBD	EACH
Log/Rock J-Hook Vanes	TBD	EACH
Rock J-Hook Vanes	TBD	EACH
Rootwad Sets (1-5 individuals per set)		
Revegetation	TBD	SETS
Erosion Control/Seed Bank Matting	TBD	FT
Live Stakes	TBD	EACH
Bareroots	TBD	ACRE
Hydroseeding	TBD	LS
Monitoring Structures	TBD	SETS
Cement (80lb bags)	TBD	LS
Rebar	TBD	LS
Warranty	TBD	LS
Other:		

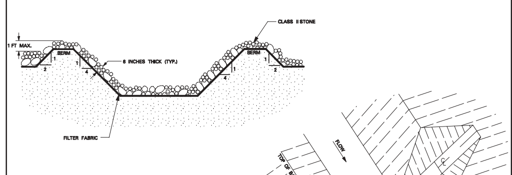
Schultz Creek Reach 1	Reach 1 Values		Reach 2 Values		Dry Fork Values
Parameter	MIN	MAX	MIN	MAX	ALL
Drainage Area, DA (sq mi)	9.5		13.4		3.8
Stream Type (Rosgen)	C4		C4		
Bankfull Discharge, Qbkf (cfs)	642		817		
Bankfull Riffle XSEC Area, Abkf (sq ft)	140.0		185.0		70.0
Bankfull Mean Velocity, Vbkf (ft/s)	4.6		4.4		
Bankfull Riffle Width, Wbkf (ft)	41.0		47.1		29.0
Bankfull Riffle Mean Depth, Dbkf (ft)	3.4		3.9		1.9
Width to Depth Ratio, W/D (ft/ft)	12.0		12.0		12.0
Width Floodprone Area, Wfpa (ft)	90	205	104		
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	2.2	5.0	2.2	5.0	
Riffle Max Depth @ bkf, Dmax (ft)	4.1	4.8	4.7	5.5	2.4
Riffle Max Depth Ratio, Dmax/Dbkf	1.2	1.4	1.2	1.4	
Max Depth @ tob, Dmaxtob (ft)	4.1	4.8	4.7	5.5	
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0		1.0		
Meander Length, Lm (ft)	287	574	330	660	
Meander Length Ratio, Lm/Wbkf *	7	14	7	14	
Radius of Curvature, Rc (ft)	74	144	85	165	
Rc Ratio, Rc/Wbkf *	2	3.5	2	3.5	
Belt Width, Wblt (ft)	143	328	165	377	
Meander Width Ratio, Wblt/Wbkf *	3.5	8.0	3.5	8.0	
Sinuosity, K	1.10		1.10		
Valley Slope, Sval (ft/ft)	0.0062		0.0053		
Channel Slope, Schan (ft/ft)	0.0056		0.0048		
Slope Riffle, Srif (ft/ft)	0.0068	0.0113	0.0058	0.0096	
Riffle Slope Ratio, Srif/Schan	1.2	2.0	1.2	2.0	
Slope Pool, Spool (ft/ft)	0.0000	0.0011	0.0000	0.0010	
Pool Slope Ratio, Spool/Schan	0.00	0.20	0.00	0.20	
Pool Max Depth, Dmaxpool (ft)	6.8	12.0	7.9	13.7	3.1
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.0	3.5	2.0	3.5	
Pool Width, Wpool (ft)	53.3	69.7	61.3	80.1	37.0
Pool Width Ratio, Wpool/Wbkf	1.3	1.7	1.3	1.7	
Pool Width/Depth Ratio	7.8	5.8	7.8	5.8	19.5
Pool Area, Apool, (ft/ft)	182.0	280.0	240.5	370.0	70.1
Pool Area Ratio, Apool/Abkf	1.3	2.0	1.3	2.0	
Riffle Length, Lriffle (ft)	41.0	123.0	47.1	141.4	
Riffle Length Ratio, Lriffle/Wbkf (ft)	1.0	3.0	1.0	3.0	
Pool-Pool Spacing, Lps (ft)	164.0	287.0	188.5	329.8	
Pool-Pool Spacing Ratio, Lps/Wbkf	4.0	7.0	4.0	7.0	
d16 (mm)	29.0		29.0		
d35 (mm)	40.0		40.0		
d50 (mm)	51.0		51.0		
d84 (mm)	110.0		110.0		
d95 (mm)	200.0		200.0		

CONSTRUCTION SEQUENCE

The following construction sequence shall be used during construction

1. Mobilize equipment and materials to the site and set up staging areas and erosion control measures
2. Restrict construction traffic to the areas denoted as haul roads and staging areas.
3. Silt fencing shall be placed around staging and temporary stockpile areas. Once construction is completed at a particular working area, temporary seeding and mulching shall be applied before progressing to a new area. Any disturbed areas shall have temporary or permanent ground cover applied within 15 working days or 30 calendar days, whichever is sooner, following the completion of grading activities in that area.
4. The sequence in which the mitigation area is constructed is to be decided by the Contractor. Contractor should finish one reach before moving on to the next. However, all newly constructed, relocated channel sections shall be stabilized and covered with erosion control matting by the end of the working day.
5. In-stream structures shall be constructed in the wet. Activity within the stream shall be kept to a minimum. Equipment will only enter the stream as necessary.
6. All disturbed areas shall be seeded and mulched before leaving the project site.
7. Prior to demobilization of equipment from site, ensure that the site is free from trash and leftover materials.
8. Demobilize equipment from site.
9. Plant riparian vegetation and permanent (pasture and riparian) seeding at the appropriate time of year.

FORD STREAM CROSSING



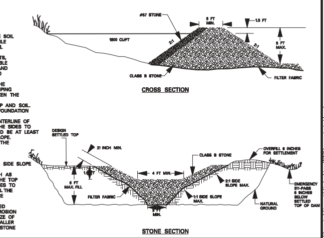
ISOMETRIC VIEW OF GRADING

NOTES:
1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
5. GRADE SLOPES TO A 2:1 SLOPE. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF CLASS A STONE, 6 INCHES THICK, LINED WITH FILTER FABRIC FOR DRAINAGE SHALL BE USED OVER THE BERM AND ACCESS SLOPES.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

TRANSPLANTED VEGETATION

CONSTRUCTION SPECIFICATIONS:

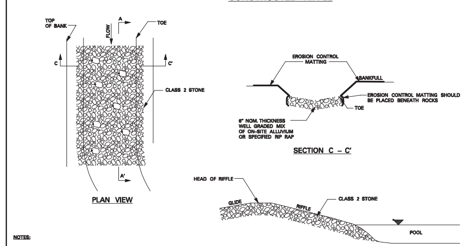
1. CLEAR, GRUB, AND STRIP THE AREA UNDER THE EMBANKMENT OF ALL VEGETATION AND ROOT MATERIAL. REMOVE ALL SURFACE SOIL CONTAINING HIGH AMOUNTS OF ORGANIC MATTER AND STOCKPILE OR DISPOSE OF IT PROPERLY. HAUL ALL OBJECTIONABLE MATERIAL TO THE DESIGNATED DISPOSAL AREA.
2. ENSURE ALL FILL MATERIAL FOR THE EMBANKMENT IS FREE OF ROOTS, WOODY VEGETATION, ORGANIC MATTER, AND OTHER OBJECTIONABLE MATERIAL. PLACE THE FILL IN LIFTS NOT TO EXCEED 9 INCHES AND MACHINE COMPACT IT. OVER FILL THE EMBANKMENT 6 INCHES TO ALLOW FOR SETTLEMENT.
3. CONSTRUCT THE OUTLET SECTION IN THE EMBANKMENT. PROTECT THE CONNECTION BETWEEN THE RIPRAP AND THE SOIL FROM THE PIPING BY USING FILTER FABRIC OR A KETWAY CUTOFF TRENCH BETWEEN THE RIPRAP STRUCTURE AND THE SOIL.
   - PLACE THE FILTER FABRIC BETWEEN THE RIPRAP AND SOIL. EXTEND THE FABRIC ACROSS THE SPILLWAY FOUNDATION AND SIDES TO THE TOP OF THE DAM: OR
   - EXCAVATE A KETWAY TRENCH ALONG THE CENTERLINE OF THE SPILLWAY FOUNDATION EXTENDING UP THE SIDES TO THE HEIGHT OF THE DAM. THE TRENCH SHOULD BE AT LEAST 2 FEET DEEP AND 2 FEET WIDE WITH A 1:1 SLOPE.
4. CLEAR THE POND AREA BELOW THE ELEVATION OF THE CREST OF THE SPILLWAY TO FACILITATE SEDIMANT CLEANOUT.
5. ALL CUT AND FILL SLOPES SHOULD BE 2:1 OR FLATTER.
6. ENSURE THAT ALL STONE(DRAINAGE) SECTION OF THE EMBANKMENT HAS A MINIMUM BOTTOM WIDTH OF 3 FEET AND A MAXIMUM SIDE SLOPE OF 1:1 THAT EXTEND THE BOTTOM OF THE SPILLWAY.
7. CONSTRUCT A MINIMUM FINISHED STONE SPILLWAY BOTTOM WIDTH AS SHOWN, ON THE PLANS, WITH 2:1 SIDE SLOPES EXTENDING TO THE TOP OF THE OVER FILLED EMBANKMENT. KEEP THICKNESS OF THE SIDES TO THE SPILLWAY OUTLET STRUCTURE AT A MINIMUM OF 21 INCHES. THE WEIR MUST BE LEVEL AND CONSTRUCTED TO GRADE TO ASSURE DESIGN CAPACITY.
8. MATERIAL USED IN THE STONE SECTION SHOULD BE A WELL GRADED MIXTURE OF STONE WITH A d50 SIZE OF 9 INCHES (CLASS B EROSION CONTROL STONE IS RECOMMENDED) AND A MAXIMUM STONE SIZE OF 14 INCHES. THE STONE MAY BE MACHINED PLACED AND THE SMALLER STONESWORKED INTO THE VOIDS OF THE LARGER STONES. THE STONE SHOULD BE HARD, ANGULAR, AND HIGHLY WEATHER-RESISTANT.



CROSS SECTION

STONE SECTION

CONSTRUCTED RIFFLE



PLAN VIEW

SECTION C – C'

PROFILE A – A'

NOTES:
1. DIG A TRENCH BELOW THE BED FOR THE INVERT INSTALLATION.
2. PLACE CLASS 2 STONE INTO TRENCH APPROXIMATELY 2-4 INCHES BELOW CHANNEL INVERT ELEVATION.
3. FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM (IF AVAILABLE) OTHERWISE USE WELL GRADED MIX OF CLASS A, CLASS B, AND #57 STONE TO THE INVERT ELEVATION OF THE CHANNEL.
4. UNDERCUT 6 FEET DOWN STREAM OF TAIL OF RIFFLE, BACK FILL ALL UNDERCUT AREAS WITH AN 8 - 10 INCH MIX OF ON-SITE ALLUVIUM.

REVISIONS	DATE
1	
2	
3	
4	
5	
6	
7	
8	
9	

SCHULTZ CREEK STREAM RESTORATION

AS BUILT DATE: TBD

CONSTRUCTION DETAILS

DRAWING NO. 1

DRAWN BY: CM, CF

CHECKED BY: FOGARTY

A&E FILE NO.: 114724

DATE: JUL. 10 2009

COMMONWEALTH OF KENTUCKY
FINANCE AND ADMINISTRATION CABINET
DEPARTMENT FOR FACILITIES MANAGEMENT
DIVISION OF ENGINEERING
FRANKFORT, KENTUCKY

Baker
MICHAEL BAKER JR., INC.
5088 West Washington Street
Charleston, West Virginia 25313
(304)-769-0821 Office
(304)-769-0822 Fax

REVIEWED DIV. OF ENGR.

FOR INTENT ONLY

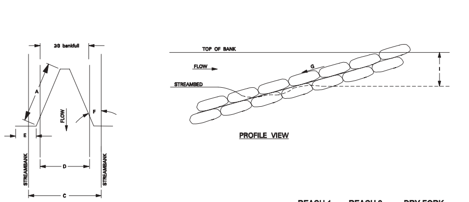
ACCOUNT NO. 660-C3WA-SC01-00

AGENCY AUTHORIZED AGENT — APPROVED FOR PROGRAM CONCEPT ONLY — DATE

SIGNATURE — P.E. — DIVISION OF ENGINEERING — APPROVED FOR PROGRAM CONCEPT ONLY — DATE

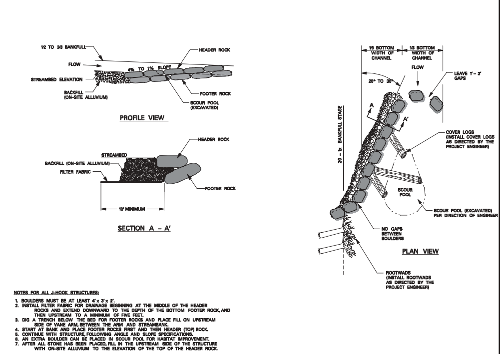
7/9/2009

CROSS VANE TYPICAL



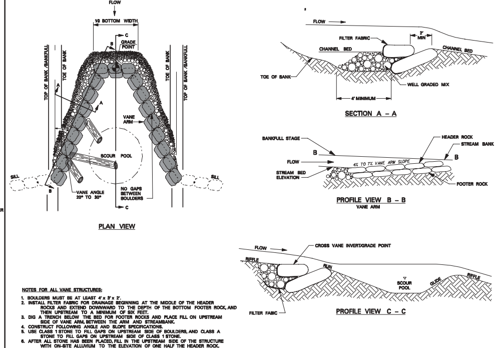
		REACH 1	REACH 2	DRY FORK
A	Vane Arm Length	60.0 ft	65.0 ft	32.0 ft
B	Invert Length	7.2 ft	8.3 ft	5.6 ft
C	Bankfull Width	41.0 ft	47.1 ft	29.0 ft
D	Bottom Width	21.8 ft	25.1 ft	16.7 ft
E	Sill Length	8.0 ft	8.0 ft	8.0 ft
F	Vane Arm Angle	21.5°	21.5°	22.0°
G	Vane Arm Slope	5.0%	5.0%	5.0%
H	Structure Length	36.2 ft	41.6 ft	32.0 ft
I	Vane Height	3.0 ft	3.3 ft	3.0 ft

J-HOOK VANE WITH COVER LOG

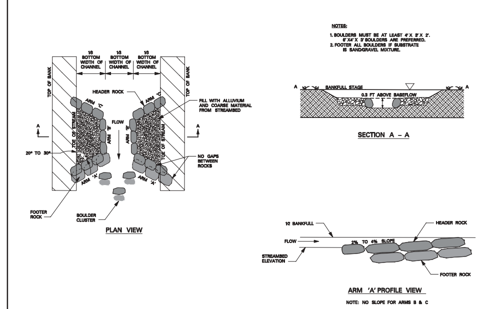


ROCK CROSS VANE TYPE 1

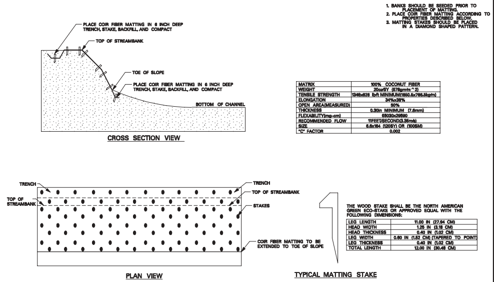
TYPE 1 CROSS VANE FOR GRAVEL/COBBLE BED RIVERS



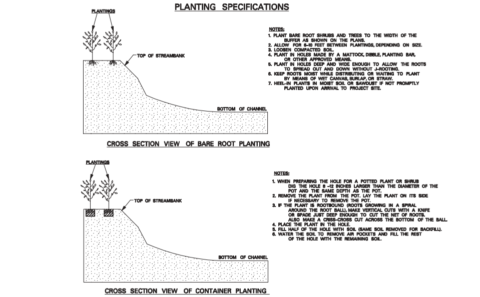
DOUBLE WING DEFLECTOR



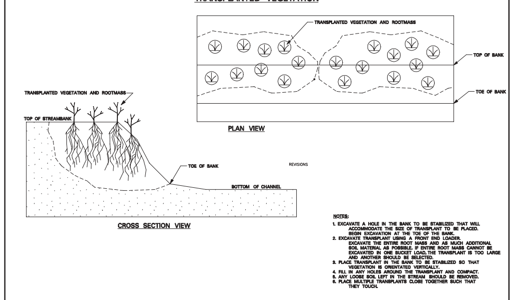
EROSION CONTROL MATTING



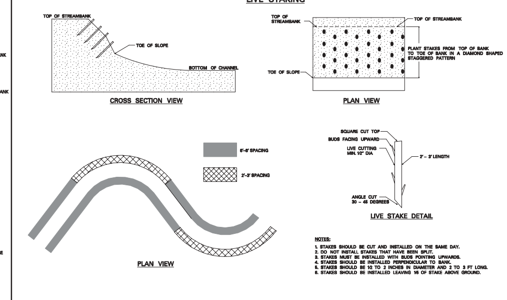
PLANTING SPECIFICATIONS



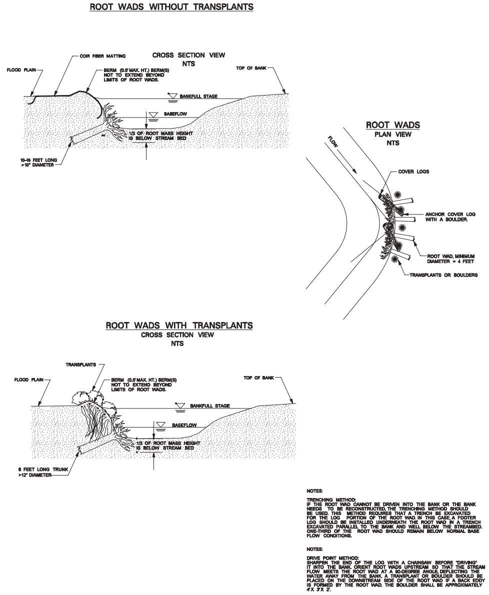
TRANSPLANTED VEGETATION



LIVE STAKING

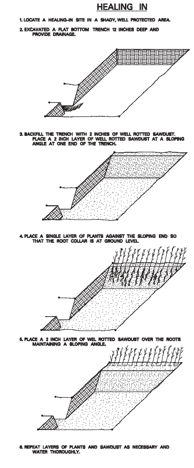


ROOT WADS WITHOUT TRANSPLANTS

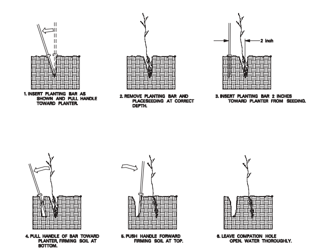


SEEDLING / LINER BAREROOT PLANTING DETAIL

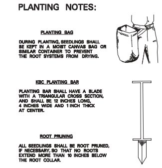
HEALING IN

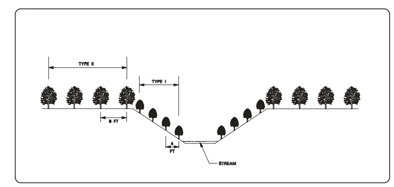


DIBBLE PLANTING METHOD USING THE KBC PLANTING BAR



PLANTING NOTES:





REVISIONS		DATE
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SIGNATURE P.E.

SCHULTZ CREEK STREAM RESTORATION

AS BUILT DATE TBD

CONSTRUCTION DETAILS

DRAWING NO. 2

DRAWN BY CM, CF

CHECKED BY FOGARTY

COMMONWEALTH OF KENTUCKY
FINANCE AND ADMINISTRATION CABINET
DEPARTMENT FOR FACILITIES MANAGEMENT
DIVISION OF ENGINEERING
FRANKFORT, KENTUCKY

A&E FILE NO. 114724

DATE JUL. 10 2009

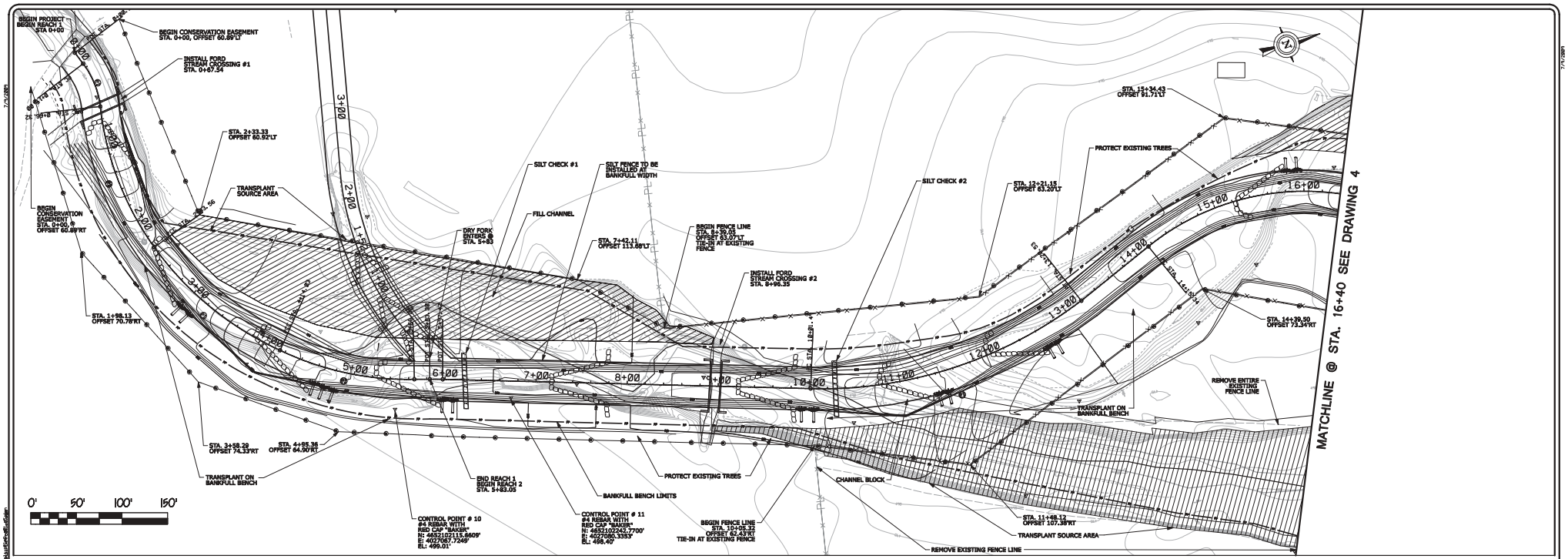
MICHAEL BAKER JR., INC.
5088 West Washington Street
Charleston, West Virginia 25313
(304)-769-0821 Office
(304)-769-0822 Fax

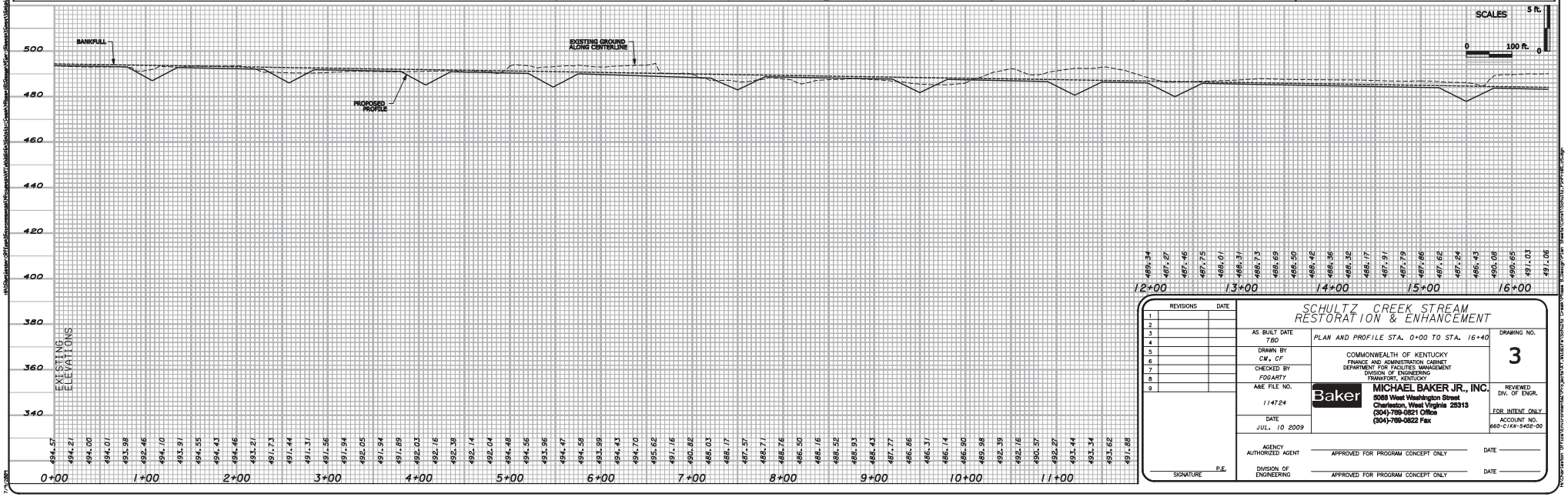
REVIEWED DIV. OF ENGR.
FOR INTENT ONLY

ACCOUNT NO. 660-C3WA-SC01-00

AGENCY AUTHORIZED AGENT ______ APPROVED FOR PROGRAM CONCEPT ONLY DATE ______

DIVISION OF ENGINEERING ______ APPROVED FOR PROGRAM CONCEPT ONLY DATE ______





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P.E. SIGNATURE

SCHULTZ CREEK STREAM RESTORATION & ENHANCEMENT

AS BUILT DATE: TBD

PLAN AND PROFILE STA. 0+00 TO STA. 16+40

DRAWING NO. 3

DRAWN BY: CM, CF

CHECKED BY: FOGARTY

COMMONWEALTH OF KENTUCKY
FINANCE AND ADMINISTRATION CABINET
DEPARTMENT FOR FACILITIES MANAGEMENT
DIVISION OF ENGINEERING
FRANKFORT, KENTUCKY

A&E FILE NO. 114724

Baker

MICHAEL BAKER JR., INC.
5088 West Washington Street
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(304)-769-0822 Fax

DATE: JUL. 10 2009

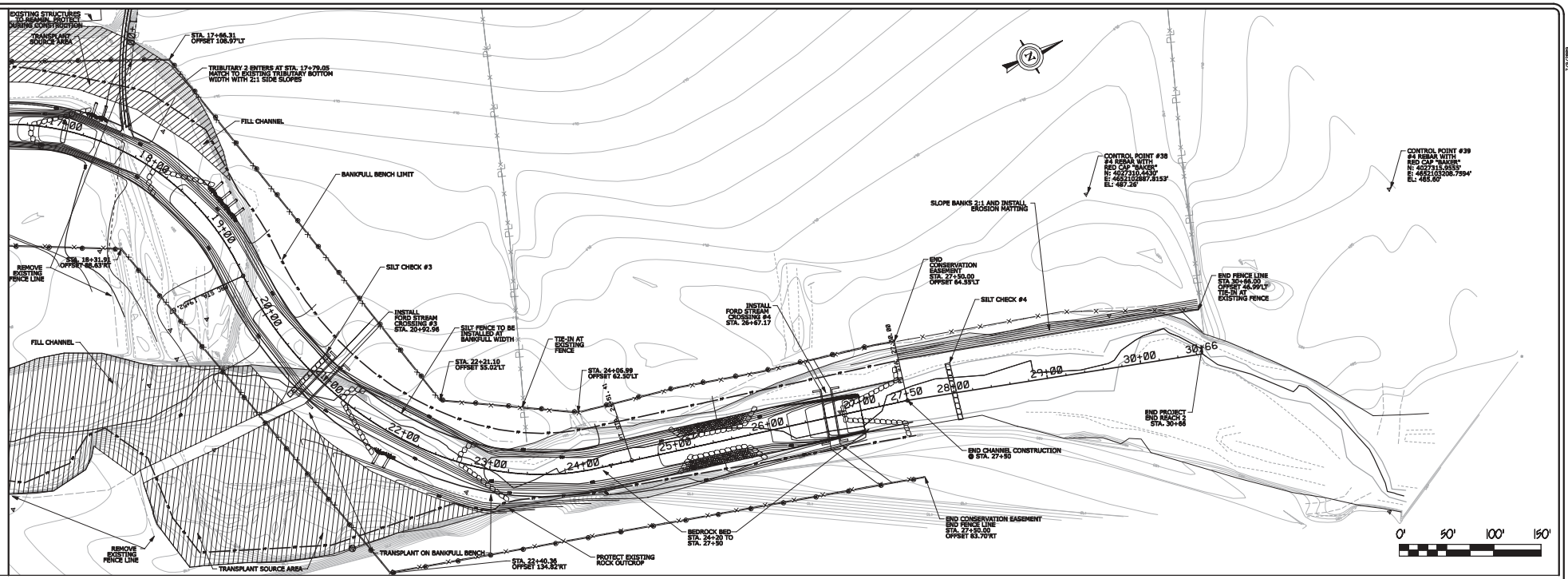
FOR INTENT ONLY

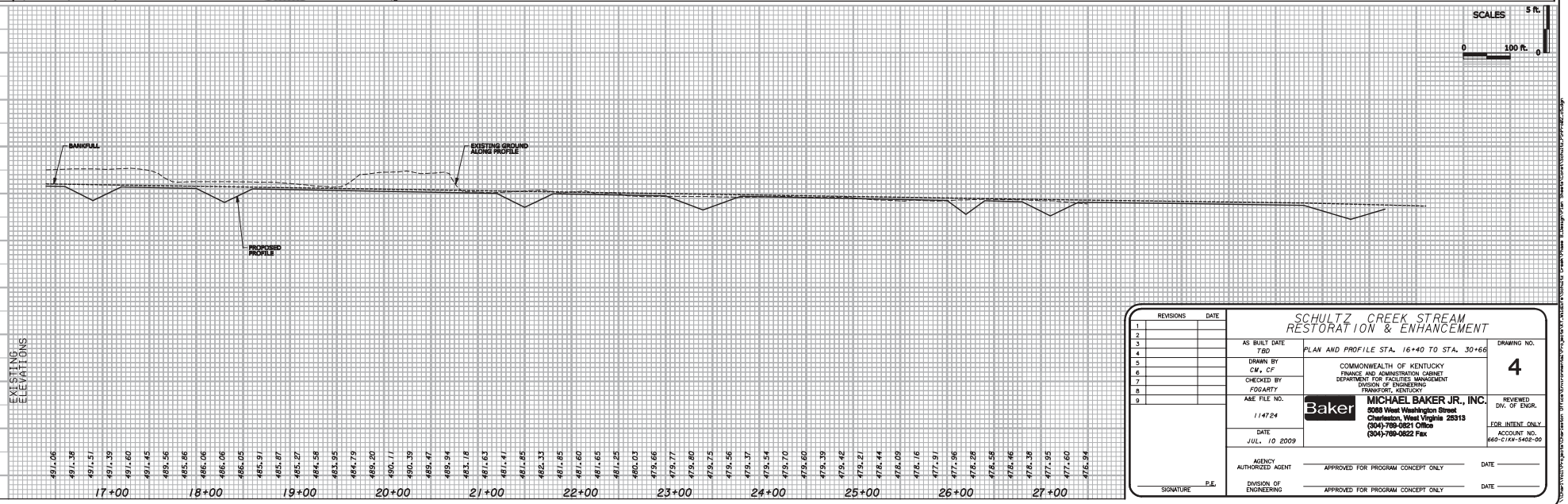
ACCOUNT NO. 660-CIKW-5402-00

REVIEWED DIV. OF ENGR.

AGENCY AUTHORIZED AGENT — APPROVED FOR PROGRAM CONCEPT ONLY — DATE

DIVISION OF ENGINEERING — APPROVED FOR PROGRAM CONCEPT ONLY — DATE





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P.E. SIGNATURE

SCHULTZ CREEK STREAM RESTORATION & ENHANCEMENT

AS BUILT DATE: TBD

PLAN AND PROFILE STA. 16+40 TO STA. 30+66

DRAWING NO. 4

DRAWN BY: CM, CF

CHECKED BY: FOGARTY

COMMONWEALTH OF KENTUCKY
FINANCE AND ADMINISTRATION CABINET
DEPARTMENT FOR FACILITIES MANAGEMENT
DIVISION OF ENGINEERING
FRANKFORT, KENTUCKY

A&E FILE NO.: 114724

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DATE: JUL. 10 2009

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